THE

Practical Teacher

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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

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DISPOSAL OF THE DEAD.

IT will not be out of place to refer to the burial of the dead—indeed, it is an intrinsic part of hygiene. The first plan of disposal adopted in this land, concerning which we have evidence was by burial in the earth. Cremation probably followed. The spread of Christianity led to the abolition of cremation, and re-established the custom of burying the dead in the earth; but, unfortunately, it was among the people, being in the neighbourhood of the places of religious assembly—a custom introduced by Romish Christianity. This still continues in country districts, but it is almost abolished in populous towns. Burial within populous areas should be entirely discontinued. There are various opinions as to the correctness of interment in the earth from a sanitary point of view. It is said that there is danger to the health of those who live in close proximity to cemeteries, from the miasms which may rise from the land: besides the political economy view, as a part of the case, in the practical removal of good soil from cultivation. In consequence of these views, an effort is now being made to re-introduce cremation, or burning of the dead, as 'the more excellent way.' There cannot be a doubt as to the propriety of encouraging cremation in some cases, when the process can be carried out in a scientific manner, as it is proposed to be performed by the 'Cremation Society of England,' but I am not prepared to advocate its use in general, or to agree to the dogma, that cemeteries must be insanitary. I think fatal cases of small-pox should be cremated; possibly some other forms of infectious disease might be so disposed of with advantage. I am of opinion that burial with charcoal or carbolic acid may tend to preserve the germs which give rise to contagious diseases for an indefinite period, and it is possible that in future times the disturbance of the remains of those who have died from the effects of infectious disease may spread new epidemics of similar diseases among the people. I am inclined to this view in consequence of the evidence which Pasteur obtained in the case of splenic fever among cattle. He found that cattle which had grazed in a field in which some interments had previously taken place of cattle dead of splenic fever, that the disease appeared among those cattle. An examination of the grass growing above the place of interment revealed the cause of the re-appearance of the malady. The splenic bacilli, which are well-defined spirilli, were found in the worm-casts which were thrown up above the place of interment. These bacilli were evidently consumed with the grass, and all the cattle which fed in that field were struck down by the disease. This event happened eighteen months after the interment of the preceding cases, although the bodies were buried several feet deep in the earth. It is possible that sheep-pox may have been produced in this way, viz., by sheep feeding in churchyards in which those dead of small-pox have been buried. I have no actual proof of this theory, but it is worth consideration in the face of Pasteur's experience; at any rate, feeding animals in churchyards should be discountenanced.

The plan suggested by the Cremation Society for giving permission to the act of cremation is not sufficiently protective. There are dangers in allowing cremation, which arises from the complete destruction of the evidence of foul play, which is capable of being effected in the crematorium. It becomes very necessary to hedge the privilege about with much stronger safeguards than the Society proposes. It is suggested by the Society that, in the first place, the individual must express a wish, either orally or in writing, to be cremated after death. Secondly, that there shall be a medical certificate as to the cause of death, given by the ordinary medical attendant, which shall be countersigned by a second medical man, 'and who shall certify that there are no circumstances connected with the death which could in his opinion make exhumation of the body hereafter necessary.' To my mind these certificates are not sufficient. It will be necessary that the evidence shall be given upon oath before a magistrate in open court; that the Medical Officer of Health for the district be present at the inquiry with authority to cross-examine the witnesses and to assist the magistrates in coming to a decision upon the point, and until such approval has been obtained, no cremation ought to be allowed.

With these safeguards, I think infectious cases

BRITISH MUSEUM

should be cremated, and in other cases it might be permitted if the deceased or his friends expressed a wish for it to be done. But I think it would be dangerous for it to be known beforehand that A. B. wished to be so treated after death. The intense activity of certain vegetable poisons and their subtle influences are such that it might be possible to evade justice, and it would be offering an inducement to unscrupulous relatives to get rid of a burthen, or put the present owner of property out of the way. When cremation is performed it must be done at a very high temperature, the produced gases must be decomposed at once into water and carbonic acid, or the mischief produced in the atmosphere will be much greater than that which can possibly arise from an ordinary well-kept burial-ground. It would be worse than that which is now produced by a so-called brick clamp. The only present objection to extramural burial in deep soil is the possibility of infecting a water supply. It is not safe to use water from wells which may exist in close neighbourhood to a churchyard, unless the well is above the level of the burial-place, and the current of water runs from the spring to the place of interment; all other wells should be closed by authority, as liable to contamination, unless they are at least three hundred feet from the place itself, and the geological formations antagonistic to filtration into the well.

Well-water drawn from the neighbourhood of churchyards often has a false reputation for purity; it may be bright and sparkling, but it may contain much albumenoid ammonia notwithstanding, or be loaded with nitrates and nitrites, which are the result of the decomposition of animal matter. When the combined nitrogen is proved by analysis to exceed one fifth of a grain in a gallon the source of the water should be carefully considered, unless it can be shown that much of the nitrogen is derived from the decomposition of nitrates alone. One grain of nitric acid in one gallon of water is of no moment, unless it be combined with evidence derived from other organic defilement. We may bear in mind, however, that every atom of ammonia corresponds with one atom of nitric acid, and that the former is convertible into the latter. Chalk springs are highly charged with nitrites, but are among the most potable kinds of water, whilst the effluent from a sewage farm has not a trace. It is the surroundings of a well, together with the chemical characteristics of the water in the neighbourhood, when compared with the analysis of the water in question, which will give the soundest information as to the value of the water for potable purposes. It must not be condemned simply because it comes from the close proximity to a burial-ground, unless there is corroborative evidence against its use, except when the well is in the actual precincts of the graveyard, when it ought to be ruthlessly condemned.

Much of the objection made to burial may be removed by simple means. First, it should be within a defined time. The custom of keeping a corpse a week after death is most pernicious, and should be strenuously objected to. The evil has arisen from the desire of the undertaker to profit by the sorrow of the friends. There is no necessity to incur expense in providing for display. The grief at the loss of a friend is as sincere after burial as before, and it is only a hysterical kind which requires the excitement of an unburied corpse to keep it up. Two days, or at the most three days, should only be allowed to elapse before interment takes place, and when the disease has been of an infectious character, forty-eight hours only. The kind of coffin in which the body is placed is of some importance. It should be impervious to air, and only strong enough to bear the weight of superincumbent earth. The body, when placed in the shell, should be put on a layer of sawdust, and filled round with the same material, the joints of the coffin well pitched so as to prevent exudation of liquid through its interstices.

Brick graves, leaden coffins, and all aids to prevent rapid decomposition are to be avoided; so is the insertion of carbolic acid or charcoal into the coffin itself, except when necessary for the safety of the bearers and friends. Those things tend to preserve organic matter from decomposition, and assist the continuance of nuisance. The depth of the grave is not material, so that there be at least five feet of earth above the last-placed coffin. It should never be allowed to place a coffin in a grave which is below the level of the subsoil water, and it is necessary, therefore, for all graveyards to be so provided that the subsoil water drains off below the level of the deepest grave. In that case bodies may be put into the earth to almost any depth, provided they are not again to be disturbed for at least a century. There ought to be a mortuary in every district, to which the dead bodies of those who have no place in which they can be left out of contact with the living may be removed as soon as possible. All those who have died a violent death should be removed to the mortuary: all inquests should be held there, and those *post-mortem* examinations made which are occasionally required for the furtherance of either the ends of science or justice.

The disposal of animals which have been killed, or which have died in consequence of infectious disease should always be by cremation or by boiling under high pressure. It is wrong in principle to bury them in the field or place at which they have been killed, but this is now the law of the land. If Pasteur's observations before alluded to mean anything, they mean the perpetuation of disease among our flocks and our herds by present mode of burial. I advocate the immediate slaughter of animals which are found to be affected with pleuro-pneumonia, splenic fever, sheep-pox, or glanders, and their destruction by heat, either in the boiling-house or the crematorium, in preference to the present plan of burial in the fields. The only way to stamp out such diseases is by energetic action in this direction, and then the complete destruction by fire of all organic matter, such as offal and manure, which has come from the victims. The intimate association which exists between unhealthiness in man and the diseases of animals is a fact which has been too often lost sight of; no country can be properly healthy if the sanitary condition of its flocks and herds is neglected. The intimate association of scarlet fever, typhoid fever, and diphtheria with infected milk has been clearly established in a hundred different instances, and no hygienic conditions can be satisfactory which ignore this possible source of disease. This part of the subject, however, will be again referred to in considering sanitary law.

SHELTER AND WARMING.

These heads may be considered in two classes: 1st, that which applies to the house; and 2nd, that which applies to the inhabitant.

The House.—The foundations are important, the

construction of the walls, the materials to be used in forming the floors and the roof—indeed, those of the whole of the fabric have a sanitary aspect. The coverings and the ventilation, together with the method adopted for warming the building are intimately associated one with the other. Some of these points have been dealt with in 'Health at School,' and I may refer the reader to the first volume of THE PRACTICAL TEACHER for the remarks which have already been made upon those subjects. I will, however, give a short résumé of the absolutely important points, and supplement them when necessary.

(To be continued.)

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The New Class-Subject, 'Elementary Science.'

(What to teach, and how to teach it.)

BY RICHARD BALCHIN.

CONTINUING the rough outlines of the easy lessons in this subject for Standard V., we have:—

LESSON XXXVII.—PHOSPHORUS.

Repeat the experiment of burning a piece of phosphorus in oxygen: note the *rapid* combustion. Also place a little dry P on an iron plate and note the *slow* combustion. In each case there is a similar combination; the chemical union of P with oxygen: in each case an oxide of P is formed, P_2O_5. In the first experiment, however, the white fumes of P_2O_5 fall into the water in which the jar rests. If a piece of blue litmus paper be dipped into this water, it turns red, showing that an acid is in solution. It is phosphoric acid, H_3PO_4. Thus:—

$$P_2O_5 + 3H_2O = 2H_3PO_4.$$

Repeat the experiment of dissolving P in bisulphide of carbon, CS_2, and pouring a little of the solution on a piece of paper. Hold the slip by one corner until the CS_2 evaporates, when the P will inflame spontaneously. These experiments show the great affinity P has for free O, *i.e.*, its ready inflammability. Hence the necessity of keeping P in water. Hence also its use in making matches; for the heat generated by a very little friction is sufficient to ignite it. For this reason, also, P is never found uncombined in nature.

LESSON XXXVIII.—PHOSPHORUS.

Recapitulate the facts of the last lesson as to the affinity of P for O, and the formation of phosphoric acid, $2H_3PO_4$. Now, phosphoric acid itself is like phosphorus in one particular, viz., its affinity for certain elements is so great that it, like P, is not found uncombined in nature. The two substances for which $2H_3PO_4$ has the greatest affinity are lime, CaO, and magnesia, MgO. The compounds which phosphoric acid forms with these two bases are, first, the various phosphates of lime, one of which, $Ca_3(PO_4)_2$, we may take as the type; and second, the phosphate of magnesia.

$$2H_3PO_4 + 3CaO = Ca_3(PO_4)_2 + 3H_2O.$$

These two compounds of phosphorus, viz., the phosphate of lime and the phosphate of magnesia, are widely distributed throughout nature; they are found in certain rocks. The boys have already had lessons upon sandstones, limestones, and granites. They have already seen that the sandstones and the limestones are generally in layers, and contain fossils: these rocks have been deposited as a sediment in water; while granite is in these three respects totally different. It is not in layers; does not contain fossils; and it is formed by the agency of fire. Show specimens of these rocks. In the latter class of rocks, viz., the granites, there is a large quantity of these two phosphates. When rocks crumble away (disintegrate) as described in the 'Reader' for Standard IV., and form fertile soils, the phosphates are taken up by plants and so find their way into the bodies of animals.

LESSON XXXIX.—PHOSPHORUS.

In the last lesson we learned how phosphorus, in the form of phosphates, finds its way into the bodies of animals. Phosphate of lime forms the greater part of the bony framework of vertebrates. Phosphorus exists, also, in the brain, in the soft roes of fish, and in vegetable and animal fibrin. It is interesting to see how largely bone is composed of phosphate of lime. In the ordinary bones of the ox we have:—

Animal matter (soluble by boiling—gelatine)	33 parts.
Phosphate of lime (in the ash when bones are burnt)	58 ,,
Phosphate of magnesia	2 ,,
Carbonate of lime (same composition as chalk)	4 ,,
Soda, and a little common salt	3 ,,
	100 ,,

Nearly all the phosphorus in use at the present day is obtained from bones. Have before the boys a fresh bone, and a stick of phosphorus kept in water. Note that the one is obtained from the other, although the two things are apparently so different. The first operation is to drive off from the bone the 33 parts of animal matter. This is done by burning or boiling. Have before the boys two bones—say the meta-carpels of a sheep, that is the bones between the knees (corresponding to our wrists) and the pastern and hoofs (corresponding to our palms and fingers). Let one meta-carpel be fresh and the other burnt. Weigh each to show how much soluble matter has been burnt out. Having previously thoroughly burnt a few fragments of bone, powder them and keep in a bottle. Finish the lesson by showing the boys—1st, the fresh bone; 2nd, the calcined bone; 3rd, the fine white bone-powder.

LESSON XL.—PHOSPHORUS.

Have before the boys the white bone-powder described in the last lesson. This powder is, for the most part, phosphate of lime, that is, phosphoric acid and lime; and we want to get out the element phosphorus. The outline of the operations may be described, and if there is in the school the necessary apparatus, some of these operations may be performed. Put some of the bone-powder into a large glass or beaker. Pour on about half a pint of dilute sulphuric acid; stir, and let settle. The greater part of the sediment, or precipitate, is sulphate of lime. In the tolerably clear liquid is most of the phosphoric acid. Test this liquid with litmus paper. It will be evident, therefore, even to the boys, that the next operation must be the separation of the oxygen from the phosphorus of this acid. In other words, we want to deoxidize phosphoric acid. Ask the boys how this may be done. I have generally managed to get from

the boys the answer, 'You must add something which has a greater affinity for oxygen than phosphorus has.' This 'something' is carbon. Pour off the phosphoric-acid liquid just obtained. Evaporate it until it becomes almost as thick as treacle. Add powdered charcoal, about one-fourth of the weight of the syrup. Put the mass into an iron saucer; heat almost to redness until perfectly dry. This is probably all that can be conveniently shown to the boys. But if the dry mass thus obtained be put into an iron retort and *gradually* heated to whiteness, there comes off, among other things, the vapour of phosphorus. This vapour is passed into a vessel of cold water, where the phosphorus condenses in yellow drops, of the same composition as the stick of phosphorus shown to the boys. The powdered charcoal combines with the oxygen of the phosphoric acid to form carbon dioxide.

A supplementary lesson on this interesting subject may be given, when the peculiar form known as red phosphorus may be described, and the manufacture of ordinary matches, and matches which light 'only on the box,' explained. This question is, however, treated with sufficient fulness in the 'Reader' for Standard V., page 143.

LESSON XLI.—SULPHUR.

Have before the boys a roll of sulphur or brimstone, a piece of native sulphur, and some 'flowers' of sulphur. *i.e.*, sublimed sulphur. Excite an interest in the substance by showing the following properties. Burn a fragment (1) in air, (2) in a jar of oxygen. A gas is produced, sulphur dioxide, SO_2, which, combining with water, gives us sulphurous acid, H_2SO_3 (*Note: not* sulphuric acid or 'oil of vitriol,' H_2SO_4; this is produced by the combination with water of the sulphur trioxide, SO_3). Mix together on a stone slab a little powdered sulphur, powdered charcoal, and saltpetre, and we have a rough sort of gunpowder; apply a lighted match. Show some of the old brimstone matches used in conjunction with the old tinder-box and flint and steel. Rub the roll of sulphur on the coat-sleeve, or on cat's skin; the sulphur becomes electric (negatively). Form the characteristic needle-shaped (acicular) crystals of sulphur, thus: Melt some fragments of roll sulphur in an iron saucer. Let the liquid cool: but as soon as a thin crust forms on the surface, make two holes in it by poking in a piece of slate pencil. Tilt the saucer, so that the remaining liquid sulphur flows out at one hole while the air is admitted through the other. Then cut round the edge of the crust and remove it; there is seen the mass of acicular crystals. Boil some sulphur in a test tube, and condense the vapour. State the facts now learned. (1) Sulphur is found native. (2) Is manufactured in the form of stick or roll sulphur, and of 'flowers' of sulphur. (3) It burns readily, and its vapour is easily condensed. (4) It melts readily, and on cooling forms needle-shaped crystals. (5) Becomes negatively electric when rubbed on wool or hair.

LESSON XLII.—SULPHUR.

Recapitulate the facts learned in last lesson. Sulphur is found native in volcanic districts, often in the cracks or fissures of volcanic lava craters. Also in beds in Sicily. But mostly sulphur occurs in combination with metals, forming metallic sulphides. Show the boys specimens of the following:—Sulphide of iron, or iron pyrites, FeS_2; this is an iron ore, but is generally smelted for the sake of the sulphur: sometimes it contains, also, a little gold; then it is worked as a gold ore. Sulphide of copper, or copper pyrites; this is nearly always a compound sulphide of copper and iron, $CuFeS_2$; it is often difficult to distinguish by the eye simply between iron and copper pyrites; the latter, however, can be more easily scratched with a penknife than the former. Sulphide of lead or galena, a lead ore, PbS, often contains a little silver. Sulphide of zinc or blende, a zinc ore ZnS. Realgar, an ore of arsenium, As_2S_2. Also we have the sulphate of lime, gypsum, $CaSO_4 2H_2O$, from which plaster of Paris is made; and sulphate of barium or heavy spar, $BaSO_4$. Perform a blow-pipe experiment with one of these metallic sulphides. Take a little galena; grind to a powder in a pestle and mortar. With the point of a penknife scoop a small cavity in a piece of charcoal. Put some of the galena powder in the cavity, and direct upon it the blow-pipe flame. The sulphide melts; a bead of pure, silvery lead is left in the cavity, around which the charcoal is coloured yellow by the depositions of the sublimated sulphur. If the galena does not fuse readily, add a grain or two of borax, or of soda, as a flux. If the teacher cannot manipulate the blowpipe, place a little of the powdered galena in a tube, and hold over a Bunsen burner; some of the sulphur will come off.

LESSON XLIII.—SULPHUR.

Sulphur is found in nature—(1) free, as native sulphur; and (2) combined, as metallic sulphides. The so-called 'native' sulphur is, however, mixed with many earthy impurities. These latter, at least most of them, are easily separated by melting. A quantity of native sulphur is placed in fire-clay jars, and subjected to a heat only just sufficient to melt it; the grosser impurities either settle to the bottom, or form on the surface to be skimmed off. The liquid sulphur is then drawn off, cooled, and sold in blocks. This form, however, requires considerable purification. To effect this, an operation is performed, which may be described to the boys, as it illustrates in an interesting manner some of the properties of this element. Rough drawings should, of course, accompany the lesson. The crude material to be purified is placed in a retort over a furnace. The neck of the retort leads into a large brick chamber, which is the condensing chamber. When heated to 228°, the sulphur fuses into a thin, transparent, brownish liquid. When heated up to about 480°, the liquid thickens considerably; in fact, it would not, in this state, flow out of an inverted vessel. Strange to say, above this temperature, it becomes thinner and thinner, until it reaches the boiling-point, 769°, when it vapourises rapidly. The vapour passes into the cool brick chamber, and is immediately condensed into a sulphur 'snow,' called 'flowers' of sulphur. This falls to the floor of the chamber, or clings to the sides. Here compare with what happens in Arctic regions, viz., the watery vapour of the breath, is often condensed into a little cloud of snow as soon as it leaves the mouth. After a time, however, the walls of the chamber become heated. That is to say, the sulphur vapour imparts to the bricks the heat it acquired in the retort. Now the sulphur vapour, instead of forming flowers of sulphur, is condensed upon

the walls in a liquid, which trickling down, is run out by a plug at the bottom of the chamber, into moulds, for stick or roll sulphur. Men remove the 'flowers' before the walls of the condensing chamber become heated.

In the case of the metallic sulphides, the sulphur is driven off by heat; generally in the form of sulphurous acid, which has, by a rather complicated process, to be deoxidised by carbon.

(To be continued.)

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How I Teach Domestic Economy.

BY MRS. WIGLEY,

Authoress of 'Marshfield Maidens,' 'Our Home Work,' 'Workers at Home,' 'Royal Series Domestic Economy,' 'Cookery and Home Comforts,' 'The Merryweathers,' 'Thoughts,' etc.

CHAPTER II.

A JUST ESTIMATE OF THE WORK AS WOMAN'S WORK.

THE very first thing that a master would do on meeting his disciples or pupils for the first time, would be to exalt the calling of which he stood to them as the teacher. We can quite understand how that a doctor would hold up the study of medicine and the healing art, a lawyer would set forth the majesty and dignity of the law, that the painter and sculptor would each largely extol the glory and beauty of their art, and so on all through.

And all these would have a very good chance of kindling an enthusiasm about these things; for their scholars come to them already inclined to second their efforts; they have chosen to become students in these very subjects because they entertain for them some especial favour, through natural ability and qualifications, or training and circumstances.

Now, though I hold that our first step in teaching domestic economy should be to give to the children a just estimation of their work—woman's work—still I well enough know that we shall very seldom meet with minds waiting to accept our conclusions. Consider for a moment the classes from which our girls are drawn. Some there are that come from thrifty, happy homes, where there is a sensible, good, managing mother, who believes the more useful her daughters are now, the more successful they are likely to be hereafter. These children may have hardships to bear, but they are sound and thorough and earnest, and we shall have no trouble with them.

But we have a far larger class who come to us from *genteel* homes. Children who like to talk much of the grandness and independence of their own families especially. Their fathers may be clerks, assistants in shops, have some employment at *the office*—which words their daughters like to make much of—or they are mechanics. The mothers of these children often were employed before their marriage at some kind of needlework, and they think a great deal of appearance. They do their work not from the love of it, and much of it is a positive hardship to them. Their girls never hear home duties exalted. 'Any dress will do to work in, any old dirty thing is good enough to wear in such jobs. I take care no one shall see me at it.' And not seldom comes also the expression, 'I hope my girls may never have to do as I am obliged to do.' They have no skill in this work, so they take no pride or pleasure in it.

Now children from these homes are not likely to think much about making 'the sweeping of the room a *fine* action.'

And besides these we have a large class of children who come from miserable homes, where the mother only too often toils and slaves against fearful odds in the face of all manner of abuse and brutal treatment, and where she is deprived of every chance to do better. 'I have nothing to clean with, even if I had anything to clean,' one of these once said to me. Poor, poor suffering sisters! how can we wonder if they scarcely understand the real significance of the word 'home,' and show a careless apathy at all our enthusiasm.

And yet it is necessary that our girls shall get a right view of this matter. How is this to be given to them?

If we could implant motives and fix principles as readily as we can raise hopes and stir the feelings, we should find no difficulty. It would then be an easy matter to make them realize the honour and nobleness of that life of loving self-abnegation which more or less every true-hearted woman *does* lead for the sake of her dear ones. We know there is a glory, yea, *a happiness*, in giving up all our own wishes, and in devoting one's best energies and powers, with single eye and single heart to bring about good for another. And we know also that thousands and tens of thousands of our sister women daily take up such a cross and carry it unflinchingly, yea, carry it gladly, year after year, so that by any means they may *save* or bless 'some.'

But though it is difficult to do all we would with our girls, we can yet do much.

First.—In our religious teaching we can specially impress upon their minds any truth or example bearing on this matter. We can bid them note the housewifely excellence of so many of our Bible women. How that Sarah the princess made the cakes of bread; that Rebecca went to the well for water and made savoury dishes, and that Rachel took care of the sheep. We can lead them to note the value set upon such qualities in the description given of *the good woman* in Prov. xxxi. And then we can give them a lesson even more directly bearing upon their own life and duty from that favourite passage of mine found in Eccles. ix. 14, 15. Surely no better words could have been written for such a purpose than these words—'There was a little city and few men within it; and there came a great king against it, and besieged it, and built great bulwarks against it. Now there was found in it a poor wise man, and he by his wisdom delivered that city. Yet no one remembered that poor wise man.'

No one knew him before his deed of daring or cleverness; no one remembered him after it, but he had his reward—*for he by his wisdom delivered his city.*

But we need not stop here. There is evidence on all hands of the mighty power of good homes. We can scarcely take up the life of any man especially great or especially good, but we shall find him tracing all his success to the training of the dear mother from whom his early lessons were received. And on the other hand, it is no difficult thing to find examples of high and holy purpose unfulfilled, and glorious lives made castaways, for the want of the home influence for good

And girls are not slow to follow our leading in another direction also. Remind them of the great statesmen sitting in council, planning, discussing, debating the best way to make our country happy, healthy, and prosperous. See that they know something of the wonderful machinery and the mighty organizations always at work for this end. Policemen, lawyers, judges, prisons for the punishment of those who do us harm. Soldiers, volunteers, and sailors to protect us in danger. Merchants and tradesmen innumerable to supply our wants. Sanitary arrangements and officers to secure good health, and hundreds of other *things and people*, always in action to do us good.

And then it is an easy step to lead them to the other end. To let them see that 'if every one would mind one, all would be amended.' That if every single home was a centre of good—if the parents were honest and upright, thrifty and industrious, and if the children were obedient and dutiful, then there would be very little left for our statesmen to do. We should be already happy and healthy and prosperous, and almost all the people employed in keeping us in order would have to find another job.

(*To be continued.*)

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Lectures on Shakspere's 'Tempest.'

BY H. MARMADUKE HEWITT, M.A., LL.M.,
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FROM ACT I., SC. 2, LINE 189, TO THE END OF ACT I.

(The figures in brackets refer to the pages of the Clarendon Press Edition.)

I NEED scarcely remind the student that the word 'ellipsis' is of Greek derivation, and that its exact equivalent in modern English is 'omission.' An elliptical sentence is one in which one or more words must be understood in order to complete the sense of the passage. It arises from a natural desire of brevity, or, in poetry, from the necessary limitations of the metre. 'The Elizabethan authors,' says Dr. Abbott, 'objected to scarcely any ellipsis, provided the deficiency could be easily supplied from the context.' I shall commence by drawing the student's attention to the following:—

We have two instances of ellipsis in the lines (10):

> 'On their sustaining garments not a blemish,
> But fresher than before.'

Here, of course, *there is* must be supplied before *not a blemish*, and *they are* before *fresher*. In '*sorceries terrible to enter human hearing*' (12), it needs but a glance to discover that the adverb *too* is to be understood before *terrible*. Again, in

> 'Nothing of him that doth fade,
> But doth suffer a sea-change
> Into something rich and strange,'

we must supply *there is* before *nothing*, and *it* or *what* before *doth suffer*.

And again in Ferdinand's impassioned exclamation—

> 'O, if a virgin,
> And your affection not gone forth!'

you are will have to be understood after *if*, and *is* after *affection*. The student will find these ellipses of constant occurrence, and by the time the play is read through will be able most likely to attempt their classification.

Notice that the word *task* (9) is parsed as verb; *Mediterranean* (11) as adj.; *litter* (12) and *sty* (14) as verbs transitive; although in common use, they are all usually met with as substantives. *Ill*, in '*nothing ill*,' is, of course, an adjective. Of nouns requiring comment, we meet with *coil* (10), meaning 'trouble'; *flote* (11), as equivalent to 'flood'; *glasses* (*ib.*), as equivalent to 'hours,' and *nerves* (19) to 'sinews.' The 'glasses' are, of course, hour-glasses. The knowledge of anatomy possessed by the ancient Romans ['nerves' is from *nervi*] would appear not to have extended to 'nerves,' in the modern signification of the term, and they were most likely in happy ignorance, for the most part, of the essentially modern ailments with the idea of which this word is connected. In regard to '*shrug'st thou malice?*' (15), the note in the Clarendon Press Edition tells us simply that *malice* is 'abstract for concrete.' Does the juvenile reader understand this? The note signifies briefly what we will venture to explain at a little greater length. *Malice*, the name of a quality (a very hateful one), is here equivalent to '*malicious person*.' Let the student turn to his Latin dictionary, and he will find that, similarly, *servitium* may mean both 'service' (abstr.) and 'a slave' (concr.), and again that *remigium* may mean both 'oarage' and 'a crew of rowers.'

Of the adverbial expressions *to point* (9) and *to every article* (10), the equivalents in modern English are 'exactly' and 'in every particular.' When Ariel subsequently asserts 'I would flame distinctly' (10), the meaning of *distinctly* is *in different places*. When Prospero asserts that the time must be *spent most preciously*, the context leads us to infer that *preciously* means 'carefully,' or 'with a full consciousness of the value of time.'

With regard to the words 'safely in harbour is the king's ship' (11), we are told that the adverb *safely* is for the adjective *safe*. Many of us may recollect having asked some old person in humble life, 'How are you to-day?' and receiving the answer, 'Nicely, thank you.'

With regard to epithets and participles, we will notice the passages: '*the still-vexed Bermoothes*' (11), '*baked* with frost' (12), '*correspondent* to command' (13), and 'not *fearful*' (19). 'Still-vexed' means constantly vexed, or harassed (*i.e.*, by storms), and with this expression the student may compare *ever angry bears* (13). 'Baked with frost' sounds curious to English ears, and has the same meaning as 'caked' or 'hardened.' The classical student may recollect the line of Ovid:—

> 'Usta gelu.'

'*Correspondent to command*' is, of course, the same as 'obedient to command.' The epithet *whist* means 'silent.' The commentators seem to have raised a discussion with regard to the logical position of the word in the two lines of Ariel's song (16):—

> 'Courtsied when you (fairies) have and kissed
> The wild waves whist.'

The point of which is as follows: Are we to understand the second of these two lines as being totally disconnected with the first, or are we to take the last word of the first line in immediate conjunction with the second line, and forming with it a single expression thus: '*kissed the wild waves whist?*' In the latter

case, we should paraphrase the expression thus: 'When you have courtsied and kissed the wild waves till they are silent.' Adopting the former view, we take the second line as independent and parenthetic; in which case, 'the wild waves being silent,' or, 'while the wild waves are silent' would be the proper paraphrase. The student will be thus reminded of the familiar 'Ablative Absolute' of the Latin Grammar.

We will now proceed to paraphrase (*i.e.*, to substitute equivalent English for) a number of passages of which the meaning is at first sight somewhat obscure. A student who is preparing the play for examination should pay especial attention to the context, as throwing light upon the meaning of particular passages. Indeed, a clever youth will often guess the meaning from remembering what goes before and after.

A good paraphrase should express every idea that is contained in the original passage. It should also be as brief and pithy as the circumstances will admit of. But the first requirement is by far the most essential. There is no objection to the student's giving two versions or paraphrases, if he cannot otherwise show the examiner that he fully understands the meaning of the passage.

'*I flamed amazement*' (10) means 'I flamed so as to cause amazement,' or, 'I caused consternation by appearing as a flame.' '*That's my spirit*' (*ib.*) is a formula of commendation. It means 'Spirit, thou art a capital fellow,' or, 'Spirit, there you showed yourself my friend.' Compare the words in line 300, '*There's my noble master.*' It is not unlike the nursery formula 'There's a good boy.' By '*his arms in this sad knot*' the poet means 'With his arms folded in this melancholy fashion.' '*Who, with a charm joined to their suffered labour, I have left asleep*' = 'Whom I have left asleep, lulled to rest by a charm in addition to the labours they have endured.' This is rather long, but it gives the full sense of the passage. '*As far as mill-wheels strike*' = 'As far as the noise of mill-wheels penetrates (or reaches).' '*Serves in offices*' (13) = 'performs duties.' '*And but he's something stained*' (16) = 'And, but for the fact that he is (or, of his being) somewhat stained.' '*Vouchsafe my prayer may know*' (17) is a confused expression, of which no explanation is given in the Clarendon Press Edition. A prayer cannot be said to know, but the person who makes the prayer can and does know. I prefer to consider it as an elliptical expression of which the full sense is 'Vouchsafe (an answer to) my prayer (and grant that I) may know.' '*They have changed eyes*' = 'they have exchanged glances,' or, 'they have exchanged glances of affection.' If it be preferred to retain '*eyes*' in the ordinary sense of the word, then 'their eyes have met' will answer the requirements of a paraphrase, though there is a hint, I think, that the glances exchanged are glances of interest rather than of mere indifference. Again, in '*make the prize light*' (18), we may substitute for the word *light* the phrase 'seem of little value.' '*My foot my tutor*' = 'What! shall my daughter (who is so ignorant) venture to correct me (who am so wise)?' '*Come from thy ward*' (*ib.*) = 'Abandon thy attitude of self-defence.' The youth had thrown himself, no doubt, into a fencing posture.

It is interesting to notice that the verb *remember* is often used by Shakspere in the sense of 'to remind,' and not 'to recollect,' as in '*Let me remember thee what thou hast promised*' (11). In another passage from this play—'*This ditty does remember my drowned father*' (17) the word has rather the sense of 'commemorates.' The verb *learn*, too, has constantly the meaning of 'to teach' (15)—a meaning which is not yet extinct among the uneducated.

The word 'villain' (13) gives me the opportunity of saying a few words about the 'deterioration' of meaning which certain of our English words have undergone. The original meaning of *villain* was 'a rustic,' but now it denotes a person of bad character. The student may easily make a list of these words. They include not only Common nouns, as *villain*, *churl*, but Nouns abstract, such as *cunning*, which at first meant only 'knowledge' or 'cleverness'; Adjectives, as *impertinent*, originally 'not to the point,' and some Verbs also.

Two well-marked metaphorical expressions occur in the portion of the play we are now considering. A metaphor is a shortened simile, and in 'explaining a metaphor,' we must point out what things are compared, and what is the resemblance between them.

Now, why are the eyelids called the '*fringed curtains of the eye*' (17)? The answer is that, in the first place, they act as curtains by covering the eyes, and, in the next place, they are provided with eyelashes, which are a sort of fringe. When Miranda says, '*There is nothing ill can dwell in such a temple*' (18), the meaning is obviously, 'Nothing evil (*i.e.*, no evil thoughts or passions) can be concealed under so fair an exterior.' As a temple contains something divine, so the human body may be spoken of as a temple, because the divine spirit of man is located within it. St. Paul, it will be remembered, speaks of the human body as a temple of the Holy Ghost. It is not quite certain whether, in speaking of the 'knotty entrails' of an oak, Shakspere is using a metaphor at all. The derivation of *entrails* (through the French, from the Latin *interanea*) shows that it meant at first only the inner parts. Perhaps the word is used here in a simple, literal meaning, and it is certainly difficult to discover any marked resemblance between the inside of a tree and the entrails of an animal.

The following passage presents considerable difficulty, in point of construction, arising from the use of *nor* in the third line:—

> 'My spirits, as in a dream, are all bound up,
> My father's loss, the weakness which I feel,
> The wreck of all my friends, nor this man's threats,
> To whom I am subdued, are but light to me.'

Without venturing to explain the mental process by which the author was led to write it, we will suggest that there are only two ways in which the passage can be logically amended. Either we must substitute *and* for '*than*,' understanding also *and* before '*the weakness*' and '*the wreck*'; or else we must alter the words '*but light*' to '*a grief*,' or some equivalent expression, understanding *neither* before '*my father's loss*,' and *nor* before 'the weakness' and 'the wreck.' There is a note in the 'Clarendon Press' which throws a certain amount of light upon the matter. By the way, as a preparation for detecting and amending the faults of expression of great writers, the student might find it instructive and not disagreeable employment in amending the slips in the grammar of the people he meets with (not, of course, to their faces), and asking

himself not only what is wrong, but why he finds fault with it. Grammar is as much a branch of science as physics are, and proof of every assertion may be demanded with equal propriety in a dispute on a point of grammar as on any other subject.

A few words as to the use of certain prepositions and conjunctions. *For* means 'as regards' in '*for the rest of the fleet*' (11), and 'inasmuch as' in '*for thou wast a spirit too delicate*' (12). *That* has the meaning of 'so that' in 'that beasts shall tremble' (15). *By* means 'past' in '*This music crept by me*' (16). *To* means 'compared to' in 'to the most of men' (19). Of course '*the most*' means here the same as 'the majority.'

The names of the classical deities have at all times been put by the poets for the particular things over which they were presumed to preside. Thus: *Venus* is commonly put for 'love,' *Ceres* for 'corn,' *Bacchus* for 'wine,' etc., etc. Now in this passage—

> 'The fires and cracks
> Of sulphurous roaring, the most mighty Neptune
> Seemed to besiege,'

'*the most mighty Neptune*' is, probably, the poetical equivalent for 'the most mighty sea,' which the poet describes as being besieged with thunder and lightning, though in this particular passage the meaning is good enough, if Neptune be taken literally as the 'God of the Sea.' A better illustration of this principle is met with later on in the play.

The elves are said (Act V., Sc. 1, line 35) to '*chase the ebbing Neptune*,' and to '*fly him as he comes back*.' This means nothing more than to run after the waves as they recede from the shore, and then, again, to run away from them as they approach it. Such will probably be the employment of many juvenile students of this play during the midsummer vacation of 1885.

(To be continued.)

—o—

How to Teach History.

BY ISABELLA LANDALE.

CAUSES OF DEFICIENT METHOD—*(continued)*.

Overloading the Memory with Unnecessary Dates.—The overloading of the memory with dates is another source of evil, as it uses up the plastic powers of the mind in the acquisition of unnecessary matter, thereby preventing the permanent acquirement of those few indispensable dates that some one has called 'the backbone of history.'

Want of a Good System of Classification.—But the greatest defect in the ordinary teaching of history is the want of a good system of classification. In such a system two things are necessary—first, a scientific method of arranging the chief facts, so as to seize their salient features and keep them vividly prominent; second, the establishment of a train of associations between these leading points and the general events, so as to give the impression of a clearly connected whole. The test of such a method of classification should be the power of automatic reproduction. For, after any portion of history had been studied in this manner, the mere recollection of the leading points should be sufficient to call up, by unconscious mental action, a vivid picture of the whole historical period with which they are connected. This should be the great aim of the teacher.

There have been many attempts at outline classification, by massing together the events of a reign or of an epoch, but what we want even more is a better system of connection and association between the principal facts which occurred during these epochs.

It is easy, doubtless, to pick faults in the present system, and easy to point out what should be done; but it is a much more difficult matter to show how the needful reforms are to be effected. However, we shall now attempt to consider in detail the best methods of teaching history, endeavouring to apply the maxims of many writers on the subject, venturing to suggest other means which have occurred to us as likely to be of use, and specially seeking to discover the method most fitted to develop and strengthen the mental faculties.

MENTAL FACULTIES CULTIVATED BY A STUDY OF HISTORY.

Before proceeding further, however, it would be well to consider which are the mental faculties capable of cultivation by the study of history? These seem to be principally, imagination, memory, and judgment.

Imagination.—The culture of the imagination is of immense consequence in its bearing on all the other mental powers, especially on that of memory, as the power of recalling images of past events depends greatly on the vivid and clear character of the original image-making power by which the impressions are formed. This is, perhaps, the earliest developed of all the mental faculties, and its wise direction in young children has a marked influence on their intellectual powers in after years.

Not less important is its bearing on the formation and development of the moral sense—indeed, its power in this direction has never been sufficiently recognised.

Memory.—For the training and strengthening of memory also there is, perhaps, no better study than history—if the method employed be, not the mere mechanical storing up of facts and dates, but an intelligent effort to cultivate the memory by attention to its laws, and to form rational trains of recollection by means of contiguity, association, and causality.

Judgment.—Finally, for the cultivation of the judgment, the study of history is invaluable, if it be taught in such a way that the pupil is led to bring the facts of history to bear upon the concerns of life. It is by this means better fitted than any other study to cultivate that rarest of endowments, common sense, in the special form of it which Carpenter defines as the automatic action of an aggregate of many previous acts of judgment.*

As imagination begins to develop at a very early age, it is to it that our first attempts at historical teaching must be addressed. We shall now, therefore, proceed to consider the

CULTIVATION OF THE IMAGINATION BY THE CHARM OF HISTORICAL ASSOCIATION.

The charm of historical association is more than a mere æsthetic aspect of history; it has a powerful effect on the imagination, and invests with surpassing interest the common localities of our daily labour. It is generally believed that our characters and lives are

* Carpenter's 'Mental Physiology,' Chapter on Common Sense.

influenced to a very large extent by our surroundings; and, if that is the case, how we should welcome anything that redeems from commonplace, scenes which might otherwise have no attraction.

This is an aspect of history peculiarly attractive to the young, and seems a natural introduction to its study. The field where a thrilling battle was fought—the house where a hero was born—the castle nobly defended by brave men—these, as concrete and visible links in the chain that binds us to the past, are easily taken hold of by a young mind; while to the old, they lend an additional pleasure to travel, enhancing the charms of beautiful scenery, or giving interest to scenes deficient in natural beauty. As the serious study of history involves considerable labour and perseverance, it is of great consequence that a taste for it should be formed in early childhood strong enough to surmount the drudgery which must be encountered afterwards; fortunately this is easily done.

To Engage the Attention and to Deepen the Impression.

The first work, as in all branches of education, is to engage the attention of the child, and arouse his interest in the subject: to do this it is necessary to present historical ideas in as concrete a form as possible, by means of 'object lessons.' History, like charity, should begin at home, and, rich as our country is in historical associations, we need never be at a loss for the materials. Let the child, or class of children, be taken for a walk to the nearest point in the neighbourhood possessing historical interest; then, with the very scene of the events before them, let the teacher, in as clear, simple, and lively a manner as possible, tell the story of what happened there. The interest of the children will be thoroughly aroused, and their minds will begin to work on the subject, if the teacher refrain from confusing their ideas by entering on more than one set of associations at a time.

The instructor would naturally return to the story next day, and try to get an account of it from the children themselves, as the effort to recall it consecutively would still more impress it on their memories. After the events of the story had been vividly painted on their minds, the hero, or principal personage connected with it, might be taken up, and, having been already introduced to the children by means of the story, he would be looked upon with interest as an old friend. Advantage might be taken of this to give a short and vivid sketch of his life, the interest of the pupils being kept up by such devices as exhibiting in the class a portrait of the hero. Indeed, pictures might be made to supersede excursions where such were inconvenient, and even the aid of a magic lantern might be called in to furnish the text of an object lesson in history.

Nothing delights a child so much as a picture or a story, so the combination of both would be powerfully attractive: the attraction would also be greatly enhanced by the fact that the stories were true; for all who have had much to do with children must recall the frequent question: 'But is it a *true* story?' and the increased eagerness with which they listen on being told that it is.

The pictorial element might be still further utilised by a series of historical picture-books, each picture being the appropriate illustration of a short account in rhyme of the subject under treatment. Such picture-books, however, should only be used as a means of fixing previous impressions, and should on no account be given to the children until they are familiar with the subjects therein treated: otherwise they would naturally hurry from one picture to another, without studying any; and the result would be a confusion of mental images, which would soon be effaced, and leave not a trace behind. These picture-books might be given to the pupils once a quarter, when they would form fresh and interesting texts for a pleasant kind of revisal.

It cannot be too strongly impressed on the teacher that all these methods of making his subject attractive are only means to an end, and should be used with moderation. This caution is especially necessary to young teachers, who are apt to be led away by the delight of the children, and to minister to their excitement instead of seeking their instruction. To produce a deep impression with the least possible physical wear and tear to the child, the first attraction must be strong; but it must have time to be realised, and to sink into the young mind, before another object is presented to distract the attention. As the great aim of education, at the earliest age, is to enable the child to fix its attention on a subject longer than it would naturally do, it is of the utmost importance that the means of attraction to the subject of attention should not degenerate into a means of distraction from it, as is too often the case. Indeed, perhaps the constant love of change and unhealthy craving for excitement which characterise the young people of this age, may be owing, in some degree, to such over-stimulation in childhood.

Of course such teaching as we have described cannot proceed on any systematic plan, and the results are of little or no value as regards historical knowledge; but it is not possible, or at least desirable, to impart that at such an early age. The results towards which a teacher should direct his efforts at this stage are: to increase the children's power of sustained attention; to form in them a strong and decided taste for history; and especially to cultivate their imaginations, and develop their moral sense.

He should seek to develop their powers of imagination by enabling them to realise events beyond their range of experience. Here great skill is necessary, on the part of the teacher, to ascertain whether the children have really succeeded in forming to themselves distinct images of the events he has been describing, or whether they have simply been drawn on by the interest of the story, without any very clear conception of the events described. Therefore, he must not be content with having secured their attention, but must endeavour to elicit their impressions by suitable questions interspersed with the narrative. If he can gain their confidence sufficiently to induce them to tell the story in their own language, he will have power to judge how far he has succeeded in cultivating their powers of imagination. Of course it would be impossible thus to obtain evidence of the impression made on every child, but after one had told his idea of the story, the other children should be encouraged to correct and amplify his account of it; by this means the child who told the story would act as a kind of interpreter, translating the master's words to the other pupils, by expressing them in his own childlike language, and conveying to the mind of the

teacher the impression formed in the minds of the other children by describing his own. Thus the gap caused by difference of age, and the consequent difficulty of a mutual understanding might be, in some measure, bridged over. As this mode of instruction presupposes great confidence in their teacher, it would not be wise to attempt it before the children have had time to know him well.

Besides cultivating the imagination such teaching should give the pupils a great fondness for history, so that, when their minds are sufficiently disciplined to enable them to begin its regular study, they may come to it with an intelligent interest strong enough to carry them successfully on.

In this first form of historical instruction the minds of the children are peculiarly susceptible; the more plastic the substance on which impressions are made, the deeper they will be; therefore, it is in early childhood that we must engrave deeply those impressions which are to last a life time. If we are to expect enduring results from the moral teachings of history, this is the time to imprint them; so we shall now proceed to consider

THE MORAL EFFECTS OF THE HEROIC IN HISTORY.

We are all familiar, through Carlyle's pages, with the combination of "Hero-worship and the Heroic in History;" and as perhaps the tendency to hero-worship is stronger in childhood than at any other period of life, it is of the highest importance that it should be utilised as a moral agent, instead of being allowed to waste itself on unworthy objects. This might be done in the most simple and natural way—so that truth and honour, courage and constancy, being presented to children in a concrete form, would be understood by them, nay, more, imitated in practice, before their minds had advanced to the stage in which even the abstract names of such virtues could have any meaning.

It is universally admitted that the weakest point of modern education is its deficiency in moral training; not perhaps as compared with the practice of our forefathers (though that is open to discussion), but as compared with the immense strides education has lately made in every other direction. The reason of this may be that moral teaching is more a matter of example than precept. But is it necessary for all purposes that the examples should be actually living? If they have lived and breathed and left their mark on time, it is enough for us—they are real and true men, with an influence for good as powerful as ever.

Very little good is done to children by fictitious accounts of the superhumanly good boys and girls held up for their imitation in 'goody-goody' books; and even works of a higher stamp, written with earnestness and power, fail of any serious result, simply because the child knows they are not true. The best of such books, therefore, come under the category of precept, and not of example.

It is to real life we must turn for moral lessons; and when we think of the many noble examples of all the virtues which are to be found in the pages of history, and which we come upon now and then with thrills of emotion, we see before us a vast store of moral influence on which to draw for the elevation of the race.

The way in which we propose to do this is by carefully selected stories from the lives of heroes, to be told to children at regular intervals, say for two years, beginning with children of six or seven. Accustomed by this means to join in admiring the best and noblest characters in history, they will gradually come to form a high standard of moral excellence, so that when they begin to acquire the inevitable knowledge of evil which comes to them from the experience of life as well as from history, their moral sense does not suffer as it might otherwise do, because evil is at once recognised as such from its contrast to the heroic goodness they have been accustomed to contemplate.

It may be objected that this is a one-sided moral teaching contrary to the natural course of things, by which a knowledge of evil is acquired from the earliest years along with the good: but as it is clearly proved that in most cases where there are more evil than good examples in the surroundings, the bias of the character is decidedly towards evil, so we may reason that where examples of good predominate, the bias will be as decidedly towards virtue. Besides it would be a dangerous attempt at deterrent moral teaching to utilise the wickedness of historical characters as a warning, in the same way that we propose to use their virtue as an example. The simple narrative of a wicked act conveys no moral lesson, the moral lies in the retribution which ultimately overtakes the sinner. As the punishment seldom follows immediately, the interval of time breaks the thread of the story, and it is not always possible to trace the connection between sin and punishment in a way to impress a child. Indeed this form of moral teaching requires to be very delicately handled, or its effect may be to encourage a spirit of self-righteousness; and the Divine Teacher Himself warned us of this when He said: 'Think ye that these men on whom the tower of Siloam fell were sinners above all men that dwelt in Jerusalem?' Anything more than a mere recital, any attempt to point a moral, would introduce the preaching element which is to be avoided, except on rare and suitable occasions. So, in describing wickedness, nothing would be left to work upon except the natural feelings of horror and indignation—feelings which lose their intensity if frequently exercised, till at length the mind becomes accustomed to look upon evil with the comparative calmness of familiarity. The tendency to imitation in childhood, which is so strong an argument in favour of moral teaching through examples of heroism, supplies as powerful a reason for withholding descriptions of wickedness from the young mind. Emotions which find expression in action are lasting in their effects, so when a child tries to imitate in his own life the virtues of the hero he admires, he is impressing indelibly this moral teaching; but emotions which cannot find vent in action pass off in mere sentiment, and serve only to blunt the moral sense; therefore wickedness, which cannot and must not be imitated, is not to be here used as a moral agent.

The system of moral education through heroic examples is already to some extent attempted, for we have many historical tales suitable for our purpose mixed with others in the ordinary reading-books; but these are painfully spelt, parsed, and read through piecemeal as tasks, while their effect as a whole is never thought of, or at least realised only by a few of the more intelligent pupils. The only way that an incident is thoroughly understood by a child is when it is told as a story, and let no teacher consider such a primitive means of instruction beneath his dignity, if thereby he can influence a child for good.

Mode of using this Moral Agent.

Let us now consider in detail the means of working this moral agent: treating first of the choice of subjects, then the style of relation, and finally the means of effecting the end in view.

Choice of Subjects.

First, as to the choice of stories: the moral examples would have to be taken from all times and countries, as it is to be feared that there is not to be found in the history of any one people enough of the heroic element to suit our purpose.

Examples of different virtues should be chosen for illustration, and care should be taken to avoid sameness, as variety is always an important element in attracting children. The usual tendency of such tales is 'to exalt the military virtues at the expense of others:' this must be guarded against, and, as the history of a country is as much concerned with its internal development as with its external activities, some of the biographical stories should be of those who, by their greatness in philanthropy, literature, science, art, or invention, deserve to be classed among their country's heroes.

These moral lessons will be all the more effective if occasionally varied by tales which may have no other merit than picturesqueness or interest, and the local history, before alluded to, might be here used with advantage to lessen any possibility of an undue straining of the moral element.

When the collective action of a body of men, or of a nation, is sufficiently pronounced or dramatic to form a story suitable for children, such will be an impressive lesson. Whatever is grand or noble in the world's heroes—in the roar of war, or in the whirr of peaceful industry—in short, 'whatsoever is lovely or of good report, if there be any virtue, if there be any praise, think of these things.'

This very important matter of choosing the moral examples is not by any means so easy as might be supposed. Any one who has ever gone to a history to pick out deliberately some such noble story to tell to an audience of little ones, will know the time and care required for the selection; and if this be the case in choosing one story, what must be the difficulty of arranging a selection large enough to last for two years?

It is clear that the work must not be left to the already overburdened teachers: it is too much for any one man to attempt; indeed, it is not speaking too strongly to say that it is a work to be attempted only by the wisest and best minds of the land, whose aid would also be necessary in expressing the stories in language suitable for children.

(To be continued.)

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Recent Inspection Questions.

[The Editor respectfully solicits contributions—all of which will be regarded as STRICTLY PRIVATE*—to this column. For obvious reasons, it cannot be stated in which district the questions have been set.]*

Physiology.

Special Subject.

Standards V. and VI. (On paper.) 1¼ hours given.

(1) How many pulmonary veins are there? What kind of blood is found in them? How do they differ from other veins in the body?

(2) Give a full description of the heart.

(3) Give an exact description of the process by which venous blood is purified.

(4) Albumen, Fat, Starch, Gluten—name the class of food to which each belongs, the particular food each is found in, and the digestive juice which acts upon it, and where.

(5) Describe the hinge joints and pivot joints, giving as many examples as you can from the human body.

Singing.

By Note on the Tonic Sol-fa System.

Six prepared songs, two of which were selected by the examiner, and sung by the whole school in two-part harmony.

Time Exercises. Written on blackboard.

Standards IV., V., and VI.

| 1:1.1: | 1: : | 1:-.: | 1:-:- | 1:-.: | 1:1.1:1 ‖

First laa-ed, the examiner pointing to each note. Then taa-tai-ed to the examiner's beating.

Standards II. and III.

| 1 :1.1 | 1 : - | 1.1: 1 | 1 : | 1.1: ‖

In the same way as above, each standard separately.

Ear Exercises.

The examiner gave chord, then vocalised the exercise, the class then vocalised it, and finally told the names.

Standards IV., V., and VI., collectively.

(1) d^1 t l s. (2) d^1 s m s. (3) s f m r. (4) f m r d. (5) d^1 d^1 d^1 d^1.

Standard III.

(1) d^1 t d^1. (2) m r d. (3) f m r. (4) d^1 t l.

Standards I. and II.

Phrases of four notes were laa-ed by the examiner the class imitating him. The names of notes were not asked for.

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Arithmetic.

Standard I.

(*Sums dictated.*)

1. Add 649, 705, 8, 19, 598.	1979.	Ans.
2. From 409 take 390.	19.	Ans.
3. Add 9219, 440, 7311, 84.	17,054.	Ans.
4. From 500 take 43.	457.	Ans.

Standard II.

(*Sums dictated.*)

1. Divide 73,209 by 11.	6655 + 4.	Ans.
2. Multiply 90,408 by 207.	18,714,456.	Ans.
3. From 400,839 take 5947.	394,892.	Ans.
4. Multiply 8904 by 782.	6,962,928.	Ans.

Standard III.

(*A Card.*)

1. From £430 18s. 7½d. take £319 19s. 11¾d. £110 18s. 7¾d. Ans.

2. Divide three hundred and seventy-five thousand eight hundred and seventeen by eighty-four.

$4474\frac{1}{84}$. Ans.

3. Find the sum of:—£309 12s. 2d.; £7520 10s.; £32,965 9s. $4\frac{3}{4}$d.; and £416 18s. $9\frac{1}{2}$d.

£41,212 10s. $4\frac{1}{4}$d. Ans.

4. If a girl put 36 stitches on each of 3 needles, and knit 120 rows, and then took one stitch off each needle every round in the next 3 rows, how many stitches would she have knit altogether?

13,266. Ans.

STANDARD IV.

(A Card.)

1. Divide ninety-one thousand and sixty-four pounds thirteen shillings and fourpence by 271.

£336 0s. $7\frac{1}{2}\frac{120}{271}$d. Ans.

2. Reduce 3 yrs. 11 mths. 3 weeks to minutes.

1,925,280 minutes. Ans.

3. From London to Newcastle is 272 miles. How much would the fares of 84 first-class passengers at 2d. a mile, 110 second-class at $1\frac{1}{2}$d. a mile, and 148 third-class at a penny a mile amount to?

£545 2s. 8d. Ans.

4. In 120,640 sq. ft. how many acres, roods, perches, etc.?

2 ac. 3 rd. 3 per. $3\frac{1}{2}$ sq. yd. 4 sq. ft. Ans.

STANDARD V.

(A Card.)

1. Make out the following bill:—

Canning Town,
London, Dec. 22nd, 1883.

Mrs. Moffatt,
Bought of Henry Bulman.

		£	s.	d.
43 lbs. of beef at $10\frac{1}{2}$d. per lb.	...	1	17	$7\frac{1}{2}$
$10\frac{1}{2}$ „ mutton at 11d. „	...	0	9	$7\frac{1}{2}$
$8\frac{1}{4}$ „ butter at 1s. 4d. „	...	0	11	0
3 score eggs at 1s. 3d. a dozen	...	0	6	3
		£3	4	6

2. Add $\frac{3}{4}$, $\frac{2}{3}$, $\frac{4}{5}$, $\frac{3}{10}$, and $\frac{9}{10}$.

$$\frac{3}{4}+\frac{2}{3}+\frac{4}{5}+\frac{3}{10}+\frac{9}{10}$$
$$=\frac{45+40+48+18+54}{60}$$
$$=\frac{205}{60}$$
$$=3\frac{25}{60}. \text{ Ans.}$$

3. What is the value of $3\frac{1}{2}$ ozs. of gold if $2\frac{1}{4}$ lbs. are worth £55 2s. 6d.?

$2\frac{1}{4}$ lbs = 27 ozs. £55 2s. 6d. = 13230d.

Worth of 27 ozs. = 13230 d.
„ 1 „ $= \frac{13230}{27}$
„ $3\frac{1}{2}$ „ $= \frac{13230\times 3\frac{1}{2}}{27}$

$$\frac{^{490}\cancel{13230}\times 3\frac{1}{2}}{\cancel{27}_{1}} = 1715\text{d.} = £7\ 2\text{s.}\ 11\text{d. Ans.}$$

4. Find the value of 9007 dresses at £1 13s. $5\frac{1}{2}$d. each.

	£	s.	d.		
	9007	0	0	= Value at £1 each	
10s. = $\frac{1}{2}$ of £1	4503	10	0	= „	10s. „
2s. = $\frac{1}{5}$ of 10s.	900	14	0	= „	2s. „
1s. = $\frac{1}{2}$ of 2s.	450	7	0	= „	1s. „
4d. = $\frac{1}{3}$ of 1s.	150	2	4	= „	4d. „
1d. = $\frac{1}{4}$ of 4d.	37	10	7	= „	1d. „
$\frac{1}{2}$d. = $\frac{1}{2}$ of 1d.	18	15	$3\frac{1}{2}$	= „	$\frac{1}{2}$d. „
	£15067	19	$2\frac{1}{2}$	= „	
				£1 13s. $5\frac{1}{2}$d.	„

STANDARD VI.

(A Card.)

1. What is the Greatest Common Measure? Find the G. C. M. of 8, 10, and 16; also the Least Common Multiple of 2, 5, 7, and 15.

8)10(1 2)16(8
8 16
2)8(4 ..
8 G. C. M. = 2.

2, 5, 7, 15
2×7×15 = 210. Ans.

2. Find how much the carpeting of a room 12 ft. 3 in. long by 7 ft. 9 in. wide would cost at 5s. 3d. a square yard.

(12 ft. 3 in. × 7 ft. 9 in. ÷ 9) × 5s. 3d.

$$=(12\tfrac{1}{4}\times 7\tfrac{3}{4}\div 9)\times 5\tfrac{1}{4}\ \text{s.}$$
$$=\frac{49}{4}\times\frac{31}{4}\times\frac{1}{9}\times\frac{\cancel{21}^{7}}{4}$$
$$=\frac{10633}{192}$$
$$=£2\ 15\text{s.}\ 4\tfrac{9}{16}\text{d. Ans.}$$

3. A owns $\frac{2}{7}$ of a ship, B owns $\frac{2}{9}$ of it, and C the remainder, which is worth £4000; what is the value of A and B's shares?

$$1-(\tfrac{2}{7}+\tfrac{2}{9})$$
$$=\frac{63-18+14}{63}$$
$$=\frac{31}{63}\text{ C's share.}$$

$\therefore \frac{31}{63} : \frac{2}{7} :: £4000 :$ A's share.

$$=\frac{\cancel{63}^{9}}{31}\times\frac{2}{\cancel{7}_{1}}\times\frac{4000}{1}$$
$$=\frac{72000}{31}$$
$$=£2322\ 11\text{s.}\ 7\tfrac{11}{31}\text{d. A's share. Ans.}$$

$\therefore \frac{31}{63} : \frac{2}{9} :: £4000 :$ B's share.

$$=\frac{\cancel{63}^{7}}{31}\times\frac{2}{\cancel{9}_{1}}\times\frac{4000}{1}$$
$$=\frac{56000}{31}$$
$$=£1806\ 9\text{s.}\ 0\tfrac{14}{31}\text{d. B's share. Ans.}$$

4. At what rate per cent. will £880 amount to £1320 in $7\frac{1}{2}$ yrs. simple interest?

£1320 − £880 = £440 total int.
£440 ÷ $7\frac{1}{2}$ = £$58\frac{2}{3}$ int. for 1 yr.

$$\therefore \underset{\pounds}{880} : \underset{\pounds}{100} :: \underset{\pounds}{58\tfrac{2}{3}} : \text{Rate p. c.}$$

$$= \frac{\overset{10}{\cancel{100}} \times \overset{2}{\cancel{176}}}{\underset{88}{\cancel{880}} \quad 3}$$

$$= 6\tfrac{2}{3}. \quad \text{Ans.}$$

STANDARD VII.

(*A Card.*)

1. If £640 gain £55 10s. in 3 yrs., how much ought £1000 gain in $2\frac{1}{2}$ yrs.?

Gain of 640 in 3 yrs. $= \underset{\pounds}{55\tfrac{1}{2}}$

" 1 " 1 yr. $= \dfrac{55\frac{1}{2}}{640 \times 3}$

" 1000 " $2\frac{1}{2}$ yrs. $= \dfrac{55\frac{1}{2} \times 1000 \times 2\frac{1}{2}}{640 \times 3}$

$$\frac{\overset{25}{\cancel{111}} \times \overset{\cancel{1000}}{\cancel{1000}} \times 5}{\underset{16}{\cancel{2} \times \cancel{640} \times 3 \times 2}} = \frac{13875}{192} = \underline{\pounds 72\ 5s.\ 3\tfrac{3}{4}d.} \quad \text{Ans.}$$

2. Find the compound interest on £240 for 3 years at 5 per cent.

	£	s.	d.	
5 p. c. $= \frac{1}{20}$	240	0	0	
	12	0	0	1st yr's. int.
5 p. c. $= \frac{1}{20}$	252	0	0	
	12	12	0	2nd yr's. int.
5 p. c. $= \frac{1}{20}$	264	12	0	
	13	4	$7\frac{1}{5}$	3rd yr's. int.
	277	16	$7\frac{1}{5}$	
	240	0	0	
	£37	16	$7\frac{1}{5}$.	Ans.

3. What should I receive for £3200 $3\frac{1}{2}$ per cent. stock by selling out at $84\frac{1}{4}$, and paying $\frac{1}{8}$ brokerage?

No. of cents. sold $= \frac{3200}{100} = 32$.

Price realised $= 84\frac{1}{4} \times 32 = \underline{\pounds 2696}$. Ans.

4. If a merchant buys 100 gallons of spirits for £125, and mixes it with 15 gallons of water, and sells the mixture at 6s. 9d. per quart, what is his gain, and the gain per cent.?

6s. 9d. $\times 4 \times 115 = £155$ 5s. 0d. selling price.

£155 5s. 0d. $- £125 = \underline{£30\ 5s.\ 0d.\ \text{gain.}}$ Ans.

$$\therefore \underset{\pounds}{125} : \underset{\pounds}{100} :: \underset{\pounds}{30\tfrac{1}{4}} : \text{Gain p. c}$$

$$= 5 : 4 :: 30\tfrac{1}{4}$$

$$= 1\tfrac{1}{5}1$$

$$= \underline{24\tfrac{1}{5} \text{ per cent.}} \quad \text{Ans.}$$

Chemistry of the Non-Metallics.

BY EDWARD AVELING, D.Sc. LONDON.

[This series of articles, whilst dealing with the subjects required by the University of London for the Matriculation Examination and with those required at the Elementary Stage of the Inorganic Chemistry (Branch X.) Science and Art Department, is intended as a practical guide to the philosophical and systematic study of the non-metallics.]

CHAPTER VI.—HYDROGEN (*continued*).

HYDROGEN NITRIDE. COMMON NAME—AMMONIA.

A. SYMBOL.—H^3N.

B. WEIGHT-NUMBER.—17.

C. FIRST PREPARATION.—From organic matter.

1. *Laboratory Method.*—Place a little animal matter, such as a piece of meat or of horn (not fat) in a test-tube (Fig. 18). Fit the mouth of the tube with a cork and

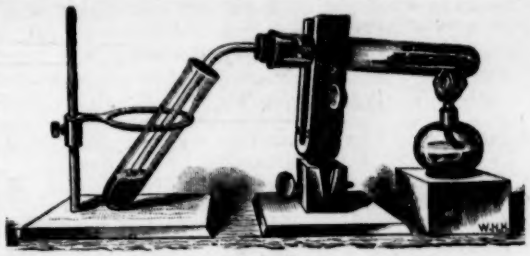


Fig. 18.

delivery-tube, and let the latter pass to the bottom of a second test-tube, containing a little water. Keep the tube containing the animal substance nearly horizontal. Heat by a spirit-lamp the bottom of the tube. Animal bodies consist in the main of the four elements, carbon, hydrogen, oxygen, nitrogen. Under the action of heat they decompose, forming various compounds of these four elements. The compound of hydrogen and nitrogen is ammonia.

2. *Symbols.*—These cannot be satisfactorily given, as the exact composition of the tissues of the animal body is still to a great extent conjectural.

SECOND PREPARATION.—From hydrogen and nitrogen. If in the graduated tube, represented in Fig. 19, a

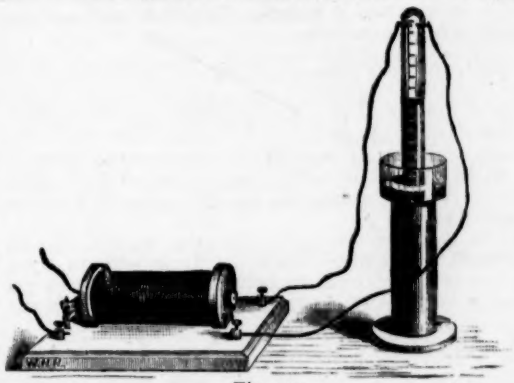


Fig. 19.

mixture of 3 parts of hydrogen to 1 part of nitrogen is placed, and sparks are sent through the mixture from the Ruhmkorff's induction coil, represented on the left-hand side of the figure, the two gases unite directly to form the compound gas ammonia. As, however, the compound is almost at once decomposed by the same electric sparks as gave rise to its formation, the ammonia must be removed as fast as it is formed, if it is wanted for the purpose of investigation.

2. *Symbols.*— $3H^3 + N^2 = 2H^3N$

3. *Weight-numbers and Volumes.*— 6 + 28. = 34; 6 vols. 2 vols. 4 vols.

EXERCISES ON THE FORMATION OF AMMONIA FROM HYDROGEN AND NITROGEN (*solved*).

61a. What volume of ammonia is formed from exploding a mixture of 3 volumes hydrogen and 1 volume nitrogen?

6 vols. H and 2 vols. N form 4 vols. H^3N

1 " $\frac{2}{3}$ " $\frac{4}{3}$ "

3 " $\frac{2 \times 3}{6}$ " $\frac{4 \times 3}{6}$ "

2 vols. H^3N.

62. Equal volumes of hydrogen and nitrogen are exploded. Which of the two gases is left, and what proportion does its volume bear to that of the original mixture? (Temperature and pressure in all cases are normal, unless the contrary is stated.)

2 vols. N need 6 H.

1 vol. " needs 3 "

∴ *The hydrogen is in excess by 2 parts out of* (1 + 3) *or* 4, *i.e., by* $\frac{1}{2}$ *of the original mixture.*

63. 20 cc. of hydrogen, and 6 of nitrogen are exploded. What volume of what gases is left?

2 vols. N. with 6 vols. H yield 4 vols. H^3N.
1 vol. „ „ 3 „ „ yields 2 „ „
6 vols. „ „ 18 „ „ yield 12 „ „
∴ 20 − 18 or 2 cc. H and 12 cc. H^3N remain.

EXAMPLES ON THE FORMATION OF AMMONIA FROM HYDROGEN AND NITROGEN (*for solution*).

57. Find the volume of hydrogen necessary to combine with 7 grams of nitrogen, and the weight of ammonia formed?
16·8 litres H, $8\frac{1}{2}$ grams H^3N.

58. Required 448 cc. ammonia. What volume of hydrogen and of nitrogen respectively is needed? .....672 cc., and 224 cc.

THIRD PREPARATION.—From sal ammoniac and slaked lime. To understand this, the best method of preparing ammonia, a preliminary experiment is necessary. Take a little solution of ammonia (badly called liquid ammonia in the shops), and dip into it some red and some blue litmus paper, with a piece of yellow turmeric paper. The red is turned blue, the blue unaltered, and the turmeric is browned. The solution is therefore alkaline. Treat a small quantity of hydrochloric acid in a similar way. The blue paper alone is affected. It is turned red. The liquid is an acid. Now combine the two. The ammonia and the hydrochloric acid unite, with the formation of dense white fumes, and the resulting compound is a salt that is neither acid nor alkaline. It affects none of the three papers, and is neutral. This salt is ammonium chloride or sal ammoniac.

This is a case of synthesis (page 495).

The symbols of this reaction are:

$$H^3N + HCl = H^4NCl$$
$$\underbrace{3+14}_{17} + \underbrace{1+35\frac{1}{2}}_{36\frac{1}{2}} = \underbrace{4+14+35\frac{1}{2}}_{53\frac{1}{2}}$$

The compound represented by the symbol H^4N, which is held to exist in the new salt thus formed, is called ammonium.

1. *Laboratory Method.* — Powder commercial sal ammoniac (ammonium chloride). Mix it with an equal weight of slaked lime (or better, soda-lime). Place the mixture in a flask (Fig. 20). Pour on the sal ammoniac and

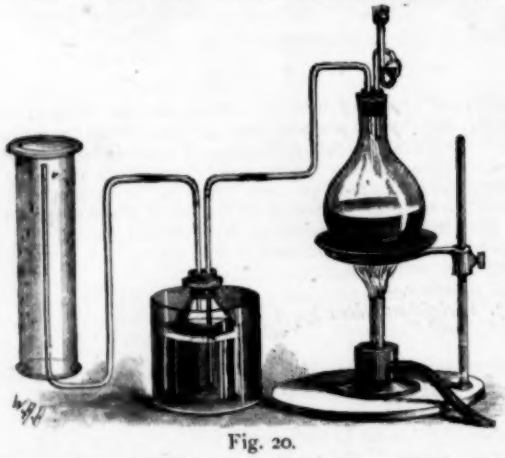


Fig. 20.

lime a little water, so as to make a paste. Fit the flask with cork and delivery tube, passing into a water-bottle, and let the exit-tube from the latter lead into a gas-jar, held mouth downwards in the air. Heat the flask gently. Ammonia is given off with steam. The steam is caught by the water in the middle portion of the apparatus, and ammonia gas is delivered into the inverted gas-jar. A salt, calcium chloride is left in the flask. Some of the gas should be caught over mercury, and some in water.

2. *Symbols.*—

$$2H^4NCl + CaO = CaCl^2 + 2H^2O + 2H^3N.$$

3. *Weight-numbers and Volumes.*—

$$\underbrace{2(4+14+35\frac{1}{2})}_{107} + \underbrace{40+16}_{56} = \underbrace{40+71}_{111} + \underbrace{2(2+16)}_{36} + \underbrace{2(3+14)}_{34}$$
4 vols.

This is the last time that the weight-numbers and volumes will be calculated in full. Only the conclusion-numbers will be given, and the student will do well to check each result by his own calculation.

EXERCISE ON THE PREPARATION OF AMMONIA FROM SAL AMMONIAC *(solved).*

61. A hectogram of ammonium chloride is heated with 6 decagrams of lime. What weight of which of the substances is in excess, and what volume of ammonia is formed?

107 grams H^4NCl with 56 grams CaO yield 4 vols. H^3N.
1 gram „ „ $\frac{56}{107}$ gram „ yields $\frac{4}{107}$ „ „
100 grams „ „ $\frac{56\times100}{107}$ grams „ yield $\frac{4\times100}{107}$ „ „

$\frac{5600}{107} = 52\frac{36}{107}$ grams CaO needed.
∴ $60 - 52\frac{36}{107} = 7\frac{71}{107}$ grams CaO are left.

$\frac{400}{107}$ vols. $= \frac{400\times11{\cdot}2}{107} = \frac{4480}{107} = 41\frac{93}{107}$ litres H^3N are formed.

EXAMPLE ON FORMATION OF AMMONIA FROM SAL AMMONIAC (*for solution*).

59. Required 119 grams ammonia. What weight of each of the two substances needed for its preparation is necessary?
$374\frac{1}{2}$ and 196 grams.

D. PROPERTIES.—1. *Condition.*—A gas, liquefied when cooled to −40°, without any increase of pressure, or by a pressure = 7 atmospheres at the ordinary temperature.

2. *Effect on Senses.*—Irritating odour; colourless.

3. *Specific gravity.*—$\frac{17}{2} = 8\frac{1}{2}$, or on the air-scale $\frac{17}{2} \div 14{\cdot}47$.

4. *Solubility.*—Very soluble in water. Water at the ordinary temperature dissolves over 700 times its volume of ammonia, and at 0°, 1149 times its own volume. This solution is probably really a compound, and not a mere mixture, as are most solutions of bodies in water. $H^3N + H^2O = H^4NHO$. The solution is probably ammonium hydrate, akin to sodium or to potassium hydrate.

5. *Relation to Combustion.*—Not combustible, and a non-supporter of combustion in ordinary air. With pure oxygen ammonia burns, forming steam and liberating nitrogen gas.

Symbols. $4H^3N + 3O_2 = 6H^2O + 2N^2$
$68 + 96 = 108 + 56$
8 vols. 6 vols. 12 vols. 4 vols.

6. *Specialties.*—Alkaline. Unites with acids, as the experiment described in the previous column, 'Third Preparation,' shows, forming salts. Another case of this reaction would be its union with sulphuric acid (hydrogen sulphate), forming ammonium sulphate.

$$2H^3N + H^2SO^4 = (H^4N)^2SO^4$$
$$34 + 98 = 132$$

In this compound, as in sal ammoniac, the basylous radical consists not of ammonia (H^3N), but of a compound of 4 atoms with 1 of nitrogen called ammonium (H^4N). This name 'is given because it is allied to ammonia, but as the compound acts as a metal the ending 'ium' is used. Ammonium has not, however, been satisfactorily isolated as yet. It acts as a monad (page 494).

If ammonia gas is passed over copper oxide, as hydrogen was in the experiment given on page 495, water and nitrogen gas are formed, whilst the metal copper is left behind.

$$2H^3N + 3CuO = 3H^2O + N^2 + Cu.$$
$$34 + 237 = 54 + 28 + 63$$
4 vols. 2 vols.

By aid of the apparatus shown in Fig. 19 (page 61),

ammonia gas can be analysed. A series of electric sparks decompose it completely into hydrogen and nitrogen.

$$2H^3N = 3H^2 + N^2$$
$$34 = 6 + 28$$
4 vols. 6 vols. 2 vols.

EXERCISES ON THE DECOMPOSITION OF AMMONIA GAS BY ELECTRICITY (*solved*).

65. What volume of hydrogen gas will result from the electrolysis of 2·8 litres of ammonia?

44·8 litres H^3N yield 67·2 litres H.

1 litre ,, yields $\frac{67·2}{44·8}$,, ,,

2·8 ,, ,, yield $\frac{67·2 \times 2·8}{44·8}$,, ,, $= 4·2$ litres.

66. What weight of ammonia must be decomposed to yield 22·4 litres of hydrogen and nitrogen?

89·6 litres H and N are yielded by 34 grams H^3N.

1 litre ,, ,, $\frac{34}{89·6}$,, ,,

22·4 litres ,, ,, $\frac{34 \times 22·4}{89·6}$,, ,,

$8\frac{1}{2}$ grams.

EXAMPLES ON THE DECOMPOSITION OF AMMONIA GAS BY ELECTRICITY (*for solution*).

60. What volume of mixed gases will result from the decomposition of 100 cc. of ammonia?..... 200 cc.

61. $8\frac{1}{2}$ grams of ammonia are electrolysed. What volume of hydrogen is formed?..... 16·8 litres.

The solution of ammonia acts on solutions of metallic salts in a way similar to that in which solutions of caustic soda or potash act. This action is of great use in testing for metals. A solution of copper sulphate if treated with caustic soda gives a pale blue precipitate of copper hydrate. A *precipitate* is the solid formed by the bringing together of two fluids. Ammonia in small quantities produces the same result. An excess of ammonia redissolves the precipitate.

Symbols. $CuSO^4 + 2NaHO = Cu(HO)^2 + Na^2SO^4$

$159 + 80 = 97 + 142$

$CuSO^4 + 2H^4NHO = Cu(HO)^2 + (H^4N)^2SO^4$

$159 + 70 = 97 + 132$

The best test for ammonia when it is present in quantities so small that its alkaline reaction and characteristic odour are not noticeable is Nessler's test.

Add to a solution of mercury chloride a solution of potassium iodide. A beautiful scarlet precipitate is formed of mercury iodide, while potassium chloride remains in solution. As this is a good instance of what is called *substitution* the student is advised to notice it very carefully, and to study the symbols.

$$HgCl^2 + 2KI = HgI_2 + 2KCl$$
$$271 + 332 = 454 + 149$$

Continue to add the potassium iodide until the scarlet precipitate is nearly redissolved. Filter. Add caustic potash until the liquid is strongly alkaline. Decant off the clear liquid. This is Nessler's solution. The presence of ammonia in any solution is shown on the addition of Nessler's solution by a brown colour, due to the formation of an iodide of a remarkable compound, that is ammonium with all its hydrogen replaced by the equivalent quantity of the dyad metal mercury (Hg_2NI).

(*To be continued.*)

—o—

Lessons in Latin.

BY THE REV. A. D. CAPEL, M.A., CANTAB.,
Formerly Examiner of Schools to Cambridge Local Examinations Syndicate.

(*Continued from page* 8.)

KEY TO EXERCISES.

EXERCISE 43.

A.

1. A year having intervened, Fabricius was sent against Pyrrhus. 2. Then he himself and the king having their camps near (each other), the physician of Pyrrhus came to him by night, promising that he would kill Pyrrhus with poison, if he would give him something. 3. War was declared against the Salentini in Apulia, and at the same time the Brundisini were taken, with their State. 4. Fifty States were received under protection. 5. The armies were led away thence to their homes. 6. The Prince Horatius was going, bearing the spoils before him, whose (better 'when his') sister, a virgin, who had been espoused to one of the Curiatii, met (lit., was meeting) him before the gate Capena. 7. And having recognised on her brother's shoulders a military cloak which she herself had made, loosens her hair, and, with tears, calls by name upon her dead betrothed. 8. The men were very much moved in that judgment (Eng., their opinion of that matter) by P. Horatius, the father, calling out that he considered that his daughter had been rightly slain.

B.

1. Inter hæc jam præmissi Albani erant equites, qui multitudinem traducerent Romam. 2. Quingenti cum imperatore Regulo capti sunt, Regulus ipse in catenas conjectus (est). 3. Et subacta Africa tum fuisset nisi habita fames fuisset. 4. Lutatius navem æger adsendit vulneratus, enim in pugna superiore fuerat. 5. Captivi Romani qui tenebantur, a Carthaginiensibus redditi sunt. 6. Postquam exempta (est) fames epulis, mensæque remotæ (sunt) amissos longe socios sermone requirunt. 7. Una cum his legatis Commius Atrebas venit, quem, super demonstraveram, a Cæsare in Britanniam præmissum. 8. Multis navibus fractis, totius exercitus perturbatio facta est.

EXERCISE 44.

A.

1. Tullus, having reigned thirty-two years, being struck by lightning, burnt (to ashes), together with his house. 2. So royal power was held at Rome, through seven kings, for two hundred and forty years. 3. Hamilcar, the general of the Carthaginians, led (Eng., took) his son Hannibal, of nine years (of age), with him into Spain. 4. Caius Marius first enrolled (Eng., was the first to enrol) a legion of six thousand two hundred men, it having been before consisted (lit., been) of four thousand. 5. Dionysius having been born twenty-five years (Eng., being twenty-five years old), obtained the sovereignty of Syracuse, and exercised it thirty-eight years. 6. Nearly five hundred years after Rome was founded (lit., being founded), Livius Andronicus taught the first fable. 7. Cæsar, having been taken by robbers, remained with them forty days, with one physician and two slaves. 8. Under him, Rome had, of heads, eighty-three thousand Roman citizens, together with those who were in the fields (Eng., labourers).

B.

1. Stadium Græcorum centum viginti quinque nostros efficit passus, hoc est pedes sexcentos viginti quinque. 2. In legione Romanâ erant cohortes decem, manipuli triginta, centuriæ sexaginta. 3. Cæsar a lacu Lemanno ad montem Juram milia passuum decem murum fossamque perduxit. 4. Prima ætas populi Romani sub regibus fuit prope per annos ducentos quinquaginta; hæc erat ejus infantia. 5. Altera ætas iterum ducentis quinquaginta annis patet, quibus Italiam subegit; hanc adolescentiam ejus

dicamus. 6. Denarii Romanorum drachmas Atticas prope æquabant, quarum sex millia unum talentum efficiebant. 7. Sexcentas tuas epistolas accepi. 8. Quumque imperavissit annos duodetriginta, cum uxore et liberis suis fugit.

LESSON XLV.

DEPONENT VERBS—SUBSTITUTE FOR PRESENT PASSIVE PARTICIPLE.

340. Several Latin verbs are not found in the Active form at all, but the Passive form has an active meaning, as 'utitur' ('he uses'), 'solamur' ('we console').

341. These verbs are called deponent verbs, because they lay aside (Lat., deponere) their right meaning.

342. Some verbs of the long E conjugation are only found in the Active form in those tenses formed from the present root, all the perfect tenses being found in the Passive form. These verbs are now called semi- (half) deponents.

343. The following verbs, 'utor,' 'fungor,' 'fruor,' 'vescor,' are followed by an ablative where we might expect an accusative; but, on examining the exact meaning of the words, and analysing the verb into its constituent parts of a noun coupled with action, we shall find these ablatives really instruments rather than objects, *e.g.*, 'I feed on apples' (Lat., 'vescor pomis'), 'the apples are really that *with* which I feed myself,' or 'I use my hands' (Lat., 'utor meis manibus'), really means, 'I do something with my hands.'

344. The Present Passive Participle is formed (compare perfect active participle, Lesson XLI.) by 'quum' with the imperfect subjunctive, as 'quum moneretur' ('being advised').

345. Deponent Verbs have all four participles, but we frequently find this form of 'quum' with the Imperfect Subjunctive used for Present Participles.

346. Deponent Verbs must be distinguished by their infinitives passive, which are as follows:—

Characteristic Vowels	ā	ē	ĕ	ī
Pres. Inf. Pass.	ari	eri	ī	iri

Of these, the form for short E verbs alone requires notice.

347. The infinitive passive is used as the infinitive active in clauses which answer the question, 'What?' to principal clause (see Lesson 36).

348. VOCABULARY 45.

English.	*Latin.*		*English Deriv.*
To assent To agree with	Assentiri, dep.		3rd R. Assens.
Mind, soul	Animus	G. Animi.	Animation
To perish	Interire	P. R. Interi.	3rd R. Interit.
To think	Opīnari, dep.		
Friendship	Amicitia	G. Amicitiæ.	
Republic	Respublica	G Rei-publicæ, doubly declined.	
To busy oneself	Versari, dep.		
Mountainous	Montuosus -sa -sum		
Woody	Sylvestris -tre		
Sometime	Aliquamdiu		
To loiter To spend	Commorari		
Greatly	Magnopere, adv.		
To delight in	Delectāri, dep.		Delectable
Only	Solus -la -lum	G. Solius (see Less. 31).	
Misery	Miseria	G. Miseriæ.	
To console	Consolāri, dep.		
To measure	Metīri	3rd R. Mens.	Immense
Silver	Argentum	G. Argenti.	
To seek	Appetĕre	Appetiv.	3rd R. Appetit.
To feed	Vesci, dep.		No 3rd R.
Skin	Pellis	G. Pellis.	Pellet
To use	Uti, dep., fol. by abl.		
Wild beasts, of	Ferinus -na -num	P. Ferin.	
Worship	Cultus	G. Cultūs.	Culture
Best	Optimus -ma -mum	R. Optim.	Optimist
Pure	Purus -ra -rum	R. Pur.	Purify
To worship	Vĕnĕrāri, dep.		Veneration
Duty	Officium	G. Officii.	Officious
To perform	Fungi, dep., fol. by abl.	3rd R.	Functus.
To enjoy	Frui, dep., fol. by abl.	3rd R.	Fruit.
Rest	Quies	G. Quietis.	Quietude
To deserve	Mĕrēri, dep., fol. by acc.	3rd R.	Merit.
In flocks	Grĕgātim, adv.		
To go To enter	Ingrĕdi, dep.	3rd R.	Ingress.
To drive	Cōgĕre	P. R. Coēgi	3rd R. Coact.
Next Nearest	Proximus -ma -mum	R. Proxim.	Approximate
I admire I wonder	Mirāri Admirari	dep.	Admiration
Penalty	Pœnæ (no sing.)	G. Pœnarum.	
Deed Doing	Factum	G. Facti.	
To imitate	Imitari, dep.		
To suffer	Pati, dep.	3rd R.	Pass. Passion.
Slaughter	Clades	G. Cladis, f. g.	
Not only—but also	Non solum—sed etiam		
Blind	Cæcus -ca -cum	R. Cæc.	
Generally	Plerumque (adv.)		
To embrace	Complecti	3rd R.	Complex.
Least	Minime, adv.		
To lead on	Inducere	P. R. Indux.	3rd R. Induct.
Any one	Aliquis, aliqua, aliquid (see Par. 307). This word is declined like Quis.		
To follow	Sequi, dep.	3rd R.	Secut. Consecutive
As soon as	Simul ac., conj.		
To slip away	Dilabi, dep.	3rd R.	Dilaps.
To fly away	Devolāre		
Equal	Equalis -le	G. Equalis (Ex. I.)	
Rather	Magis, adv.		
Ancient	Antiquus -qua -quum	R. Antiqu.	
To prefer	Anteponĕre	P. R. Anteposu.	3rd R. Anteposit.
Money	Pecunia	G. Pecuniæ	Pecuniary
Blame Fault	Culpa	G. Culpæ.	Culpable
To spurn	Aspernari, dep.		
Truth	Veritas	G. Veritatis.	Verity
Barbarian	Barbarus -ra -rum	R. Barbar.	

349. EXERCISE 45.

A.

1. Non assentior iis (37) qui (27) cum (20) corporibus (15) simul (42) animos interire opinantur. 2. Veræ (29) amicitiæ difficillime (Eng., 'with very great difficulty') reperiuntur (41) in iis (37) qui (27) in republicâ versantur. 3. Locis (9) montuosis et sylvestribus in quibus (27) aliquamdiu commorati sumus magnopere delectamur. 4. Sola spes (41) hominem (5) in miseriis consolabitur. 5. Magnos (20) homines (5) virtute (26) metimur non fortuna (40). 6. Scythæ (Eng., the Scythians) aurum (40) et argentum non non appetebant; lacte (12) et melle (1) vescebantur, pellibus utebantur ferinis. 7. Is (37) cultus deorum (27) optimus est (38), ut (6) eos (37) purâ et integra (35) mente (40) veneremur. 8. Omnibus (29) vitæ (11) officiis functus, fruitur ea (37) quiete, quam (27) meritus est. 9. Elephanti (35) gregatim semper (33) ingrediuntur: ducit (9) agmen (39) *maximus natu* (Eng., oldest), cogit ætate (44) proximus.

B.

1. I wonder that you (35) do not fear (3) the penalty of those people (37) whose deeds (27) you imitate. 2. Cæsar in all (29) civil (38) wars (16) suffered no (17) defeat (clades) unless (43) (except) through (3) his (20) lieutenants (10). 3. Not only fortune (40) herself (40) is blind, but she also generally makes (44) those (37) blind whom (27) she has embraced. 4. That (man) (37) especially enjoys riches (39) who (27) least wants riches (39). 5. (Those) who (use 'qui') led on by the fortunes (40) of any one have followed (Eng., sought) his (37) friend-

ship, as soon as fortune (40) has slipped away, all (29) fly away (fall off). 6. The equals (Eng., contemporaries) of Cicero rather admired (imp. tense) the ancient orators (8); he himself (40) preferred the eloquence (27) of his own (20) times (17). 7. We especially admire him (37) who (27) is not moved (43) (influenced) by money. 8. The greatest (41) blame is in him (37) who (27) spurns the truth. 9. Let him enjoy that (37) which (27) he has deserved. 10. The Barbarians feed on milk (12) and (1) honey and use skins (for) garments (14).

LESSON XLVI.

PARTITIVE GENITIVE.

350. We now come to the Latin idiom generally first noticed by those preparing exercise-books for beginners—viz., the use of the Partitive Genitive.

351. Students who have gone through a course of French will have little difficulty with this use of the genitive.

352. A noun in Latin is generally put in the genitive case when only a part of that included in the word is referred to, as 'much good,' 'no (Lat., nothing) kindness,' etc., etc. These expressions in Latin would be 'multum boni,' 'nihil bonitatis.'

353. Some verbs and adjectives are said to govern the genitive, but these genitives can all be explained as really partitive genitives—*e.g.*, 'Res adversæ admonent religionum.' 'Adverse circumstances remind (men) of superstitions.' 'Miserescite regis,' 'Pity (ye) the king.' 'Omnes immemorem beneficii oderunt,' 'All men hate him who is unmindful of a benefit.'

354. Distances are measured by so many thousands of paces, in which the word 'passuum' is really a partitive genitive.

355. The syllable 'gen.' will be added in the vocabularies to all verbs and adjectives followed by the genitive.

356. VOCABULARY 46.

English.	*Latin.*		*English Deriv.*
A standard	signum	G. signi	significant
To obtain possession of	pŏtīri, dep., gen. or abl.		3rd R. potit
To remember	meminisse, no pres. root, gen.	P. R. mimim.	
Fond	stŭdiōsus-sa -sum	R. studios	
Philosopher	philosophus	R. philosoph.	
Skilled	pĕrītus -ta -tum	R. perit	
Naval	nāvālis -le	R. naval, Ex. I.	
Athenian	Atheniensis -se	R. Atheniens, Ex. I.	
Mindful	mĕmor, gen.	G. memŏris	
Old age	sĕnecta	G. senectæ	
Characteristic	proprium	G. proprii	propriety
Folly	stultitia	G. stultitiæ	
Vice	vĭtium	G. vĭtii	
To forget	oblivisci, dep., gen. of person		3rd R. oblīt.
Treachery	prōdĭtio	G. prodĭtiōnis	
Sufficient	sātis, gen.		satiety
Ability / Force	cōpia	G. copiæ	copious
Politeness	lĕpor, or lepos	G. lepŏris	
No (not much)	pārum, adv.		
Ornament	ornāmentum	G. ornamenti	
To fill (thoroughly)	explēre	P. R. explēv.	3rd R. explēt
The world	mundus	G. mundi	mundane
To mix	admiscēre	P. R. admiscu	3rd R. admist and admixt
Error	error	G. errōris	
Nature	nātūra	G. naturæ	

English.	*Latin.*		*English Deriv.*
Greedy	ăvĭdus -da -dum	R. avid	
Novelty	nŏvĭtas	G. novitātis	
Go	ădeo, adv.		
To persevere	persĕvērāre		perseverance
Loving	diligens	G. diligentis	
Not...even	ne...quidem (a word must be inserted between)		
To lie	mentīri, dep.		3rd R. mentīt
Rich	dīves	G. divĭtis	
Embroidered	pictus -ta -tum	R. pict	
Garment	vestis	G. vestis	vest
To err	errāre		
England	Anglia	G. Angliæ	Anglican
Unwise	insīpiens	G. insipient, Ex. I.	
Wickedness	probrum	G. probri	
Except = unless	nīsĭ		
To owe—ought	debēre	P. R. debui	3rd R. debit
To look to	intuēri, dep.		3rd R. intuit
To reverence	rĕvērēri, dep.		3rd R. reverit
Old man	sĕnex	G. senis, ex. con.	senile
To subdue	dŏmāre	P. R. domu	3rd R. domit
To fear	pāvēre	P. R. pav	3rd R. none
Any man (you please)	siquis -qua -quod, decl. like qui (Less. 30).		

357. EXERCISE 46.

A.

1. Romani (20) signorum potiti sunt. 2. Jubet (29) mortis (8) te (35) meminisse Deus (27). 3. Pythagoras sapientiæ (6) studiosos appellant (43) philosophos. 4. Themistocles peritos belli (16) navalis fecit (43) Athenienses. 5. Nonne (4) venturæ (19) memores jam (33) estis (38) senectæ? 6. Proprium est (38) stultitiæ aliorum (31) vitia cernere (37) oblivisci suorum (20). 7. Miltiades proditionis est accusatus (2) quod (27) quum (13) Parum (Paros) expugnare (17) posset (Eng. 'he was able,') a (31) pugna (43) discessisset (31). 8. In hac (37) satis erat (38) copiæ in illâ (37) autem (38) leporis parum. 9. Quod (27) auri (40), quod (27) argenti (45), quod (27) ornamentorum fuit (38) id (37) Verres abstulit (37). 10. Deus (27) bonis (20) omnibus (29) explevit mundum, mali (15) nihil (31) admiscuit.

358. B.

1. The nature of men (5) is (38) greedy of novelty. 2. Epaminondas (Lat., same) was (38) so loving of the truth (45) that (6) not even (in) joke did he lie (imp. sub.). 3. He is rich (in) horses (13), rich (in) an embroidered garment, and (in) gold (40). 4. Romulus was (38) the first (20) of the Roman (20) kings (8). 5. What (30) matter (gen.) is now (33) being done (16) (Lat., waged) in England? 6. That (man) (37) who (27) accuses (2) another (31) (Lat., alter) of wickedness ought to look to himself (35). 7. It is (the part) of a youth (41) to reverence old men. 8. It is (the part) of virtue (26) to subdue (those things) which (27) all (27) fear. 9. It is (the part) of any man to err; of no one (17), except an unwise (man), to persevere in error. 10. Who (30) is *fond* of these (37) (things)?

LESSON XLVII.

ORDINALS, DISTANCES, AND DATES.

359. The ordinals, telling you which of a series a noun is, are all O and A adjectives—as *m.* primus, *f.* prima, *n.* primum (first), and are as follows (The Feminine and Neuter forms will not be printed in subjoined list):—

360.

1st primus	20th vicesimus
2nd sĕcundus	21st vicesimus primus
3rd tertius	30th trigesimus

4th quartus	40th quadrogesimus
5th quintus	50th quinquagesimus
6th sextus	60th sexagesimus
7th septimus	70th septuagesimus
8th octavus	80th octogesimus
9th nonus	90th nonagesimus
10th dēcĭmus	99th undecentesimus
11th undecimus	100th centesimus
12th duodecimus	200th ducentesimus
13th tertius decimus	1000th millesimus
14th duodevicesimus	2000th bismillesimus.

361. Distances from one place to another are sometimes expressed by an ordinal with 'milliarium'—*e.g.*, 'ab urbe Roma duodecimo milliario,' 'at the 12th milestone from the city of Rome,' or, as we say, '12 miles from Rome;" but distances passed over, as well as distances from, are expressed by a cardinal, with 'millia passuum' (partitive genitive), as 'exercitus quinque millia passuum ab Ictumilis consedit.' 'The army halted five thousand paces (5 miles)' from Ictumili.

362. Dates in Latin are expressed by means of 3 days in each month, the other days being calculated from the next of these days in front.

The 1st day of all months is called its Kalends.			
,, 5th or 7th	,,	,,	Nones.
,, 13th or 15th	,,	,,	Ides.

It will be noticed that the Nones are 8, or, as the Latins said, the 9th day (counting as they do in music—calling the next before the 2nd or day before the next but one the 3rd, and so on) before the Ides.

363. The four months which had the Ides on the 15th, were March, July, October, May.

364. All the days of a month after the Ides were reckoned as so many days before the Kalends of the next month, thus, 26th October (which is, as we say, six days before November 1st) was called the 7th day before the Kalends of November, and is written, 'ante diem septimum Kalendas Novembres,' shortened into 'a. d. vii. Kal. Nov.' Again, the 11th of May, being four days before the Ides of the month, was called the 5th day, etc., etc., and was written 'ante diem quintum Idus Maias,' or 'a. d. v. Id. Mai.'

365. The names of the months are adjectives, not substantives; some O, and A, and some I, and are as follows:—

Januarius	Maius	September
Februarius	Junius	October
Martius	Julius	November
Aprīlis	Augustus	December.

Aprilis is declined like Tristis. The last four months, thus: September-bris-bre, with three forms in nom.

366. VOCABULARY 47.

English.	*Latin.*		*Eng. Deriv.*
Milestone	milliarium, n.g.		
Anio (a river)	Anio	G. Aniēnis, m.g.	
River.	flūvius	R. fluvi.	
To conquer completely	dēvincere	devīc	3rd R. devict.
Authority	ditio	G. ditionis.	
To be well acquainted with	percallescere	P. R. percallu	No 3rd R.
Spurinna	The haruspex who warned Cæsar to beware of the Ides of March.		
To drive out	exăgĕre	P. R. exēg.	3rd R. exact.
Insurrection	sēditio	G. -onis.	
Common people	plebs	G plebis	plebeian
Hateful	invisus-a-um	R. invis.	
To cross over	transīre	P. R. transi.	3rd R. transit.
Reign	regnum, n.g.		
To review	lustrare		
Suddenly	repente, an adv.		
To withdraw	subdūcĕre	P. R. subdux.	3rd R. subduct.
Amidst	inter, prep. gov. acc. case		
To arise	oriri, dep. verb.		3rd R. ort.
To write	scribĕre	P. R. scrips.	3rd R. script.
To make-(war)-on	inferre	P. R. intŭl.	3rd R. illāt.
Etruscan	Etruscus -ca -cum	R. Etrusc.	
Aid	auxĭlium, n.g.		auxiliary.
To arise	exoriri, dep. verb		3rd R. exort.
To step forward	prōcēdĕre	P. R. process.	3rd R. process.
Strength	robur	G. roboris, n.g.	corroborate
To call forth / To challenge	prōvŏcare	P. R. provocav.	3rd R. provocat.
To fight	dēcernĕre	P. R. dēcrēv.	3rd R. decret.
To put	impōnĕre	P. R. impŏsu.	3rd R. imposit.
To undertake	suscīpĕre (io)	P. R. suscēp.	3rd R. suscept.
Punic	Punicus -ca -cum	R. Punic	
To bring to an end	transīgĕre	P. R. transeg.	3rd R. transact.

367. EXERCISE 47.

A.

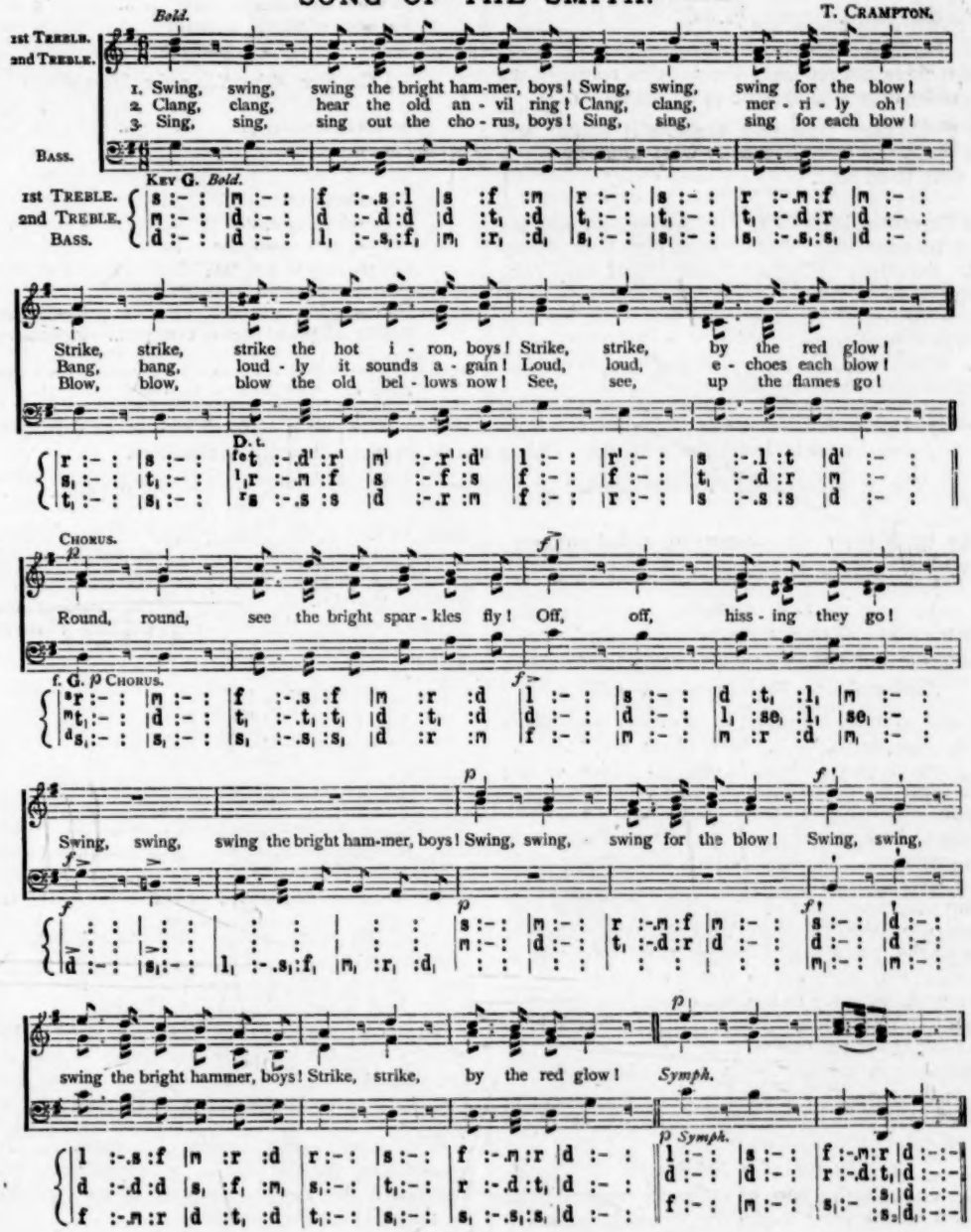
1. Anno (17) trecentesimo nonagesimo tertio post (17) urbem (7) conditam (41) Galli (10) iterum (20) ad urbem accedebant (41) et quarto milliario trans (12) Anienem fluvium consederant (37). 2. Mithridates Ponti rex (8) qui (27) a Pompeio anno (17) sexcentesimo octogesima octavo post (17) Roman conditam (41) devictus est, quinque et viginti (44) gentium (38), quas (27) sub (16) ditione habuit (7) lingua (22) percalluit. 3. Cæsar Spurinnæ 'Scis-ne' (Eng., 'Do you know?'), inquit, (Eng., 'says') 'Idus Martias jam (43) venisse?' (19). 4. Sexto decimo anno (17) post reges (8) exactos populus (16) Romae seditionem fecit (31). 5. Undevicesimo anno (17) post exactos reges (8) C. Marcius plebi invisus fieri (Eng., to become) cœpit (37). 6. Anno quingentesimo undetricesimo ingentes (29) Gallorum (10) copiæ (46) Alpes (12) transierunt. 7. Ita (17) anno (17) septimo decimo Italia ab Hannibale liberata (12) est. 8. Scripsimus A. D. V. Id. Apriles, MDCCCXLIV.

B.

1. In the thirty-seventh year (17) of (his) reign, when (13) he was reviewing (imp. sub.) (his) army (19), he was suddenly withdrawn (from) the eyes (18) of men (5) amidst a tempest (35) (which had) arisen. 2. In the second year (17) also (20) again (20) Tarquin made war (16) (on) the Romans (Dat. case), Porsena, the king (8) of the Etruscans, bringing (12) him (37) aid. 3. In the three-hundred-and-third year (17) from (31) the city (7) being founded (33), the decemviri (Lat., same word) were created (37), who (27) wrote (imp. sub.) the laws (5) for the State (14). 4. A new (33) war (16) having arisen with (20) the Gauls (10), in the four-hundred-and-sixth year (17) of the city (7), again, (20) a Gaul (10) stepped forward, remarkable for (his) strength and arms (36), and called for one (44) of (26) the Romans that he might fight with (20) him (35) with arms (36). 5. In the five-hundred-and-thirty-eight year (17) after the city (7) was founded (33) L. Paullus and C. Varro are sent (44) (43) against (17) Hannibal (26). 6. In the fourteenth year (17) after (43) Hannibal (26) came (19) into (4) Italy (20), Scipio was made (43) consul (17) and sent (43) into (4) Africa. 7. In the fifteenth year, L. Cornelius Sulla put an end (40) to it (37) (Dat. case). 8. Then (19) a third war (16) against (17) Carthage (16) was undertaken, in the six-hundred-and-fifth year (17) from (31) the city (7) being founded (33), in the four-hundred-and-first year (17) after (43) the second Punic war (16) had been brought to an end.

(To be continued.)

SONG OF THE SMITH.*

T. CRAMPTON.

Bold.
1st TREBLE.
2nd TREBLE.
1. Swing, swing, swing the bright ham-mer, boys! Swing, swing, swing for the blow!
2. Clang, clang, hear the old an - vil ring! Clang, clang, mer - ri - ly oh!
3. Sing, sing, sing out the cho - rus, boys! Sing, sing, sing for each blow!
BASS.
KEY G. Bold.
1st TREBLE.
2nd TREBLE.
BASS.
Strike, strike, strike the hot i - ron, boys! Strike, strike, by the red glow!
Bang, bang, loud - ly it sounds a - gain! Loud, loud, e - choes each blow!
Blow, blow, blow the old bel - lows now! See, see, up the flames go!
D. t.
CHORUS.
Round, round, see the bright spar - kles fly! Off, off, hiss - ing they go!
f. G. p CHORUS.
Swing, swing, swing the bright ham-mer, boys! Swing, swing, swing for the blow! Swing, swing,
swing the bright hammer, boys! Strike, strike, by the red glow! Symph.
p Symph.

* Direct appropriate actions *ad lib.*

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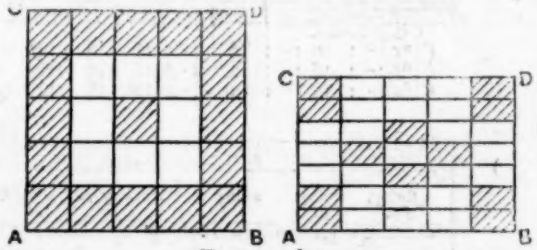
Some skill in marking-off inch divisions has been given in the work of Standard I. In the drawing for Standard II. it will be necessary more frequently to mark off halves and quarters of inches.

1. *The use of a Set-Square.*

A set-square with a base of 2½″ and a perpendicular of 6″ will be the most useful for the exercises which follow.

Rule a line A B across the paper, low down on it, and 5″ long (Ex. 1). Mark the inch divisions. Press down the ruler with three fingers of the right hand. Place the set-square on the upper side of the ruler, with the second finger of the left hand in the hole in its centre, and its hypotenuse on the left. Move the set-square until its edge comes to point A. Place the first and third, as well as the second finger of the left hand on the set-square, and the thumb and little finger of the same hand on the ruler. Keep all firm and steady. Rule a line A C the length of the edge of the set-square. On the line A C mark-off five 1″ divisions.



Exs. 1 and 2.

From all the points in A C rule lines across the paper with the set-square, rather longer than A B. In the same manner, with the set-square rule lines from the points in A B parallel to A C. Shade.

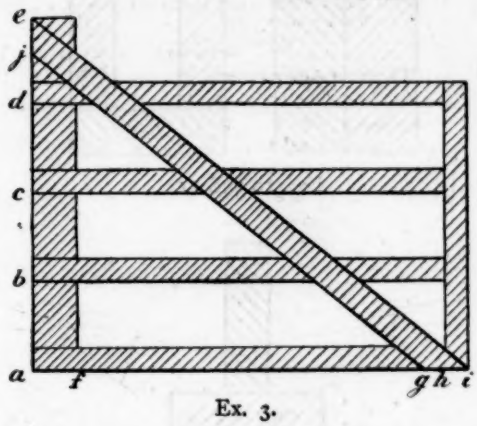
Great care must be exercised in seeing that the scholars hold the ruler and set-square in such a way that they will not shift when the lines are being ruled. The set-square cannot always be held as above described. The right, or left, or both hands will need to be employed under certain circumstances. It will be necessary for the teacher to demonstrate on the blackboard the various methods of manipulation as the necessity for their use arises.

In Exercise 2, A B is divided into five 1″ divisions, and A C into seven half-inches.

Exercise 3 represents a gate. Rule *ae* 4″ long. Mark off *b*, *c*, *d* 1″ apart. Mark off ¼″ above *a*, *b*, *c*, and *d*, respectively. Rule all the cross lines. On the line *ai* mark *af* ½″, *gi* ½″, and *hi* ½″. Rule lines upwards from *f*, *h*, and *i*. Join *ei*. Mark *ej* ½″ and rule *jg*.

2. *Easy Drawing to Scale.*

Measure a book, the cover of which is less than 9″ by 6″, and rule its dimensions accurately on the blackboard, using the ruler and set-square. The scholars will find that they can make, on their paper, a drawing of the cover of the book shown on the blackboard by ruling lines of the same length as those drawn by the teacher. It is supposed that they are using a slate, or piece of paper, 10½″ by 7½″ (outside).



Ex. 3.

Stand two slates side by side against the blackboard. They will be found, including the frames, to measure 15″ by 10½″. Make a drawing of them, the actual size, with ruler and set-square, on the blackboard. The children will find that they have not enough room on their slates to mark 15″ or 10½″. As soon as they have discovered this, tell them to use half-inches for inches.

In their drawing they must put 7½″ for the longer side, and 5¼″ for the shorter. At the bottom of the slate all should write a note of this kind :—'In this drawing, half-an-inch is used to show one inch.'

Nothing has been said about drawing to scale, because explanations would be likely to confuse. All that these young people need know at present is the practical way of overcoming the difficulty of representing an object larger than their slate or paper.

It is necessary to place in a vertical position those objects which are to be represented in the same way as the slates, so that the vertical, oblique, and horizontal lines may be drawn as taught to Standard I.

This work for Standard II. is Solid Geometry in its simplest form. In it we draw the elevation or projection on the vertical plane of objects having two dimensions, and which are placed parallel to the vertical plane.

As it is difficult to mention any one object which is always to be found in an elementary school, and which is invariably of the same dimensions, I select a modulator, 2 feet broad by 4 feet 9 inches long (exclusive of rollers), as likely to be most frequently at hand. This should be carefully measured in presence of the children, and its true dimensions, as in the case of the slates, drawn on a blackboard, or on two blackboards placed side by side. Tell the members of the class to make a drawing of it themselves, using an inch to show a foot. Their drawing will actually measure 2″ by 4¾″. At the bottom of the slates this note should be written :—'In this drawing, an inch is used to show a foot.'

Measure the wall in front of the class, or other large right-angled object which is a definite number of yards long or broad. The children should use an inch to show a yard, and, when the drawing is finished, write a note stating this, as before.

By working numerous examples like the book-cover, slates, modulator, and wall, the scholars will learn to employ an inch to show a yard, an inch to show a foot, a half-inch or a quarter of an inch to show an inch, a foot, or a yard, as the case may require. When considerable experience in this practical work has been gained, they may be told that the drawing of objects, greater or less than their real size, is called 'Drawing to scale,' and that they may shorten the writing at the bottom of the slate by simply putting 'Scale, an inch to a yard,' and the like.

Some difficulty will arise in finding objects having only right-angles, and which are a definite number of yards or feet in length and breadth. The teacher should measure a number of the flat objects in the class-room when the children are not present, and select those which have no odd inches or half-inches over and above the feet or yards. Anything that is 5′, 5½″ (′= feet), for example, gives trouble ; for, if an inch be taken to represent a foot, how will the way to show 5½″ be made easy to children ? If the odd inches be 3, 6, or 9, there is not the same trouble, as a quarter, a half, and three-quarters of an inch represent them respectively.

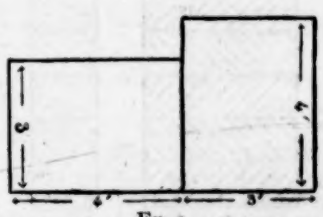
The opening in a wall for a door or a window is regulated by the arrangement of the bricks. Enlargement upwards is always 3″ (the thickness of a brick with mortar), or a multiple of 3″ ; and increase in width is by 4½″ or 9″ (the half or whole length of a brick), or a multiple of them. If the school is well-built and furnished, the measurements of similar things will be found uniform, excepting a slight variation due to the contraction and expansion of the materials, caused by heat and cold, dryness or damp.

In a cheaply-built school, a great deal of irregularity will be found in making measurements. Unseasoned wood expands or warps much more than that which is seasoned, and bad workmanship shows itself, among other things, in inaccurate dimensions.

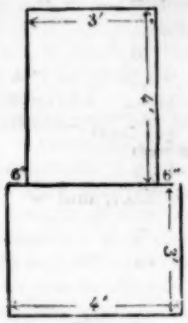
Every opportunity should be taken to impress upon the scholars the waste and inconvenience which arises from inaccurate and careless measuring.

The following twelve exercises will be found useful, and should be given by measuring the objects when they are placed before the class :—

Exercises 4 and 5 are taken from two blackboards placed together. Each board is actually 3 feet by 4 feet. They are here drawn to a scale of ¼″ to 1′. The children should draw them by using 1″ to show 1′.

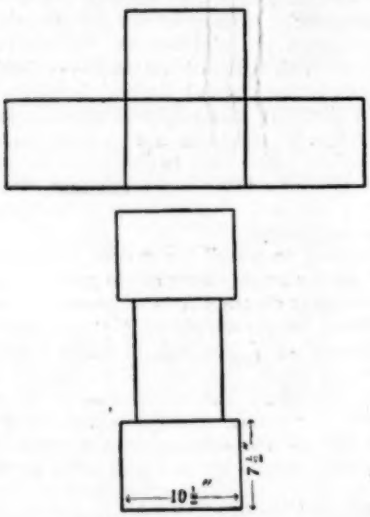


Ex. 4.



Ex. 5.

Exercises 6 and 7 represent slates placed in front of a blackboard, and resting on a piece of wood laid on the pegs of the easel. The outside measurement of each slate is the same as the one figured. They

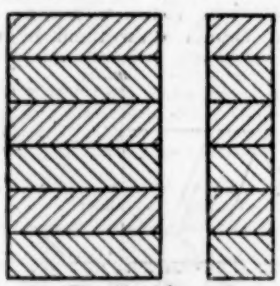


Exs. 6 and 7.

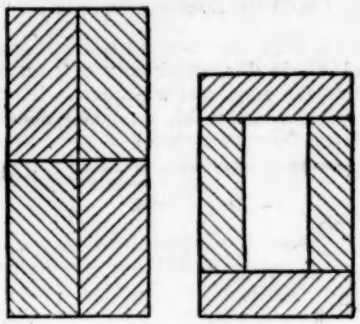
are drawn in the illustrations to a scale of $\frac{1}{16}$" to 1". The children should draw them by using $\frac{1}{4}$" to show 1".

Bricks are easy to get, and are pretty uniform in their dimensions—8½" long, 4" wide, 2½" thick. Exercises 8 to 15 are taken from bricks built up before the children. In the illustrations they are drawn to a scale of $\frac{1}{10}$" to 1".

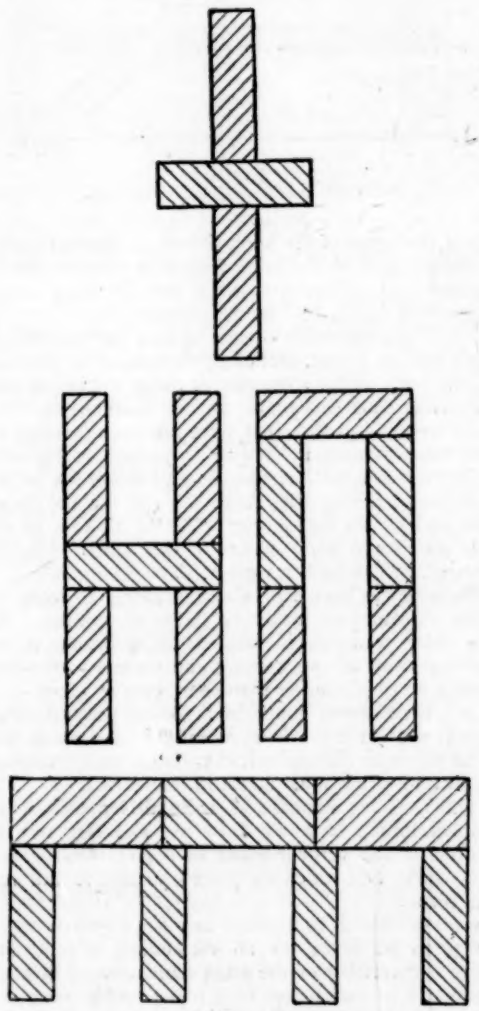
The scholars should draw Examples 8, 9, 10, and 11, using $\frac{1}{2}$" for 1". They might draw Examples 12, 13, 14, and 15, using $\frac{1}{4}$" for 1".



Exs. 8 and 9.



Exs. 10 and 11.



Exs. 12, 13, 14, and 15.

In the next article, plane geometry and drawing to scale, for Standard III., will be taken into consideration.

ANSWERS TO
Pupil Teachers' Examination Papers.
FIRST YEAR.
Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Simplify the following fraction, and give the answer in a decimal form:— $\frac{12\frac{2}{7}}{31\frac{5}{14}}$ of $\frac{(\frac{2}{7}+\frac{1}{3})}{(\frac{2}{7}-\frac{1}{3})}$.

$$\frac{12\frac{2}{7}}{31\frac{5}{14}} \text{ of } \frac{(\frac{2}{7}+\frac{1}{3})}{(\frac{2}{7}-\frac{1}{3})}$$
$$= \frac{\overset{2}{\cancel{90}}}{7} \times \frac{\overset{1}{\cancel{14}}}{\underset{5}{\cancel{45}}} \times \left(\frac{27+7}{63}\right) \times \frac{63}{(27-7)}$$
$$= \frac{\overset{2}{\cancel{90}}}{7} \times \frac{\overset{1}{\cancel{14}}}{\underset{5}{\cancel{45}}} \times \frac{34}{\underset{1}{\cancel{63}}} \times \frac{\overset{9}{\cancel{63}}}{\underset{1}{\cancel{20}}}$$
$$= \frac{34}{5}$$
$$= 6\cdot8. \quad \text{Ans.}$$

2. Divide $4\cdot\dot{7}14285\dot{7}$ by $2\cdot75$, and say what decimal the result is of $1\frac{1}{2}$.

$$\frac{4\cdot\dot{7}14285\dot{7} \div 2\cdot75}{1\frac{1}{2}}$$
$$= 4\tfrac{7}{15}\tfrac{1}{4}\tfrac{4}{2}\tfrac{2}{8}\tfrac{8}{5}\tfrac{5}{7} \div 2\tfrac{75}{100} \times \tfrac{2}{3}$$
$$= 4\tfrac{2}{3} \div 2\tfrac{3}{4} \times \tfrac{2}{3}$$
$$= \frac{\overset{8}{\cancel{24}}}{7} \times \frac{4}{\underset{1}{\cancel{11}}} \times \frac{2}{\underset{1}{\cancel{3}}}$$
$$= \frac{8}{7}$$
$$= 1\cdot\dot{1}4285\dot{7}. \quad \text{Ans.}$$

3. If $\frac{4}{7}$ of $\frac{3}{5}$ of a meadow measure 3 a. $11\frac{1}{2}$ p., what will $\frac{3}{11}$ of the remainder measure?

$$1 - (\tfrac{4}{7} \text{ of } \tfrac{3}{5}) = \tfrac{23}{35} - \tfrac{12}{35} = \tfrac{11}{35}$$
$$\tfrac{3}{11} \text{ of } \tfrac{11}{35} = \tfrac{3}{35}$$

	a.	p.	a.
$\frac{3}{35} : \frac{3}{11}$ ::	3	$11\frac{1}{2}$	: x
	= 1	a. 2 r. $5\frac{5}{8}$	p. Ans.

4. Three men are set to do a piece of work. The first could do $\frac{1}{4}$ of it alone in 2 hours; the second could do $\frac{1}{3}$ of the remainder in an hour, and the third could then finish it in ten minutes. In what time could they do it working together?

First could do in 1 hr. $\frac{1}{2}$ of $\frac{1}{4} = \frac{1}{8}$
Second " " $\frac{1}{3}$ of $\frac{1}{2} = \frac{1}{6}$
Third " $1 - (\frac{1}{8} + \frac{1}{6})$ or $\frac{17}{24}$ in 10 min.
∴ He could do in one hour $\frac{17}{24}$ or $\frac{1}{2}$.
Working together they could do $\frac{1}{8} + \frac{1}{6} + \frac{1}{2}$

$$= \frac{9+4+12}{24} = \tfrac{25}{24} \text{ in 1 hr.}$$

	hr.	hr.
∴ $\frac{25}{24}$: $\frac{1}{2}$ ::	1	: x
$= \frac{1}{2}$ hr. =	57 min.	36 sec. Ans.

FEMALES.

1. Find by Practice my net income from my gross income of £480 after deducting an income tax of $6\frac{1}{4}$d. in the £.

$6\text{d.} = \frac{1}{40}$ of £1
$\frac{1}{4}\text{d.} = \frac{1}{96}$ of 6d.

£	
480	= Gross income
12	= Amt. of tax at 6d. in the £
1	= " $\frac{1}{4}$d. "
13	= Total tax at $6\frac{1}{4}$d. "
£467	= Net income. Ans.

2. Make out and receipt the following bill:—

29½ yds. cotton at 4½d. per yd.
168 buttons at 1s. 0½d. per doz.
42 towels at 3s. 11½d. each.
492 yds. lace at 10d. per yd.
15 yds. print at ¾d. per qr. yd.

18, Suffolk Street,
Norwich, 10th March, 1884.

Mrs. Walton,

Bought of Robinson and Co., Warehousemen.

	£	s.	d.
29½ yds. cotton at 4½d. per yd.	0	11	0½
168 buttons at 1s. 0½d. per doz.	0	14	7
42 towels at 3s. 11½d. each	8	6	3
492 yds. lace at 10d. per yd.	20	10	0
15 yds. print at ¾d. per qr. yd.	0	3	9
	£30	5	7½

Received same time,
J. Lyne,
For Robinson and Co.

3. What is the worth of 37 cwt. 2 qrs. 14 lbs. of lead at £7 10s. 9d. per cwt.?

	£	s.	d.	
2 qrs. = ½ cwt.	7	10	9	= Value of 1 cwt.
			37	
	278	17	9	= Value of 37 cwt.
14 lbs. = ¼ of 2 qrs.	3	15	4½	= " 2 qrs.
	0	18	10½	= " 14 lbs.
	£283	11	11½	= " 37 cwt. 2 qrs. 14 lbs.

4. How many yards of calico at 7¼d. per yard must be given in exchange for 10,708 yards of silk at 3s. 0½d. per yard?

One yard at 3s. 0½d. $= \frac{3\text{s. } 0\frac{1}{2}\text{d.}}{7\frac{1}{4}\text{d.}} = 5$ yds. at 7¼d.
∴ 10,708 yds. = 10,708 × 5 = 53,540 yds. Ans.

Grammar.

MALES AND FEMALES.

1. Parse and analyse the following passage:—

'Under a spreading chestnut-tree
The village smithy stands;
The smith, a mighty man is he,
With large and sinewy hands.'

Sentence.	Kind of Sent.	Subj.	Predicate.	Object.	Extension.
(*a*) Under a spreading chestnut-tree the village smithy stands	Princ. Sent.	The village smithy	stands		under a spreading chestnut tree (place)
(*b*) The smith, a mighty man is he, with large and sinewy hands.	Princ. Sent.	The smith, he	is a mighty man, with large and sinewy hands		

Under—prep., showing reln. between *tree* and *stands*.
a—disting. adj., limiting *tree*.
spreading—partl. adj. of quality, qualg. *tree*.
chestnut—com. noun, used as adj. of quality, qualg. *tree*.
tree—com. noun, neut., sing., obj., gov. by *under*.
the—distng. adj., limiting *smithy*.
village—com. noun, used as adj. of quality, qualg. *smithy*.
smithy—com. noun, neut., sing., nom. to *stands*.
stands—irreg. intrans. verb, act., ind., pres., sing., 3rd, agreeing with its nom. *smithy*.
smith—com. noun, masc., sing., nom. to *is*.
mighty—adj. of quality, qualg. *man*.
man—com. noun, masc., sing., nom. after *is*.
he—pers. pronoun, masc., sing., 3rd, nom. in app. with *smith*.
with—prep., showing reln. bet. *man* and *hands*.
large—adj. of quality, qualg. *hands*.
and—cop. conj., joining clauses 'large hands' and 'sinewy hands.'
sinewy—adj. of quality, qualg. *hands*.
hands—com. noun, neut., plur., obj., gov. by *with*.

2. What affixes are used in the above passage, and what is their effect upon the roots to which they are joined?

-ing, forms pres. participle from verb, *spread, spreading.*
-age, forms one noun from another; *villa, village.*
-y, forms adjective from noun; adj. form used as noun; *smith, smithy.*
-y, in *mighty*, as in *smithy.*
-y, in *sinewy*, as in *smithy.*

3. What is the *Infinitive Mood?* Give a list of verbs after which the sign of the infinitive is omitted.

The Infinitive Mood is the form of the verb which simply names the action without making an assertion; it is a verbal noun, and generally does the work of a noun.

The sign *to* before the Infinitive Mood is omitted after the following words:—May, can, must, shall, will, do, dare, bid, feel, have, hear, let, make, see, and need. Sometimes also after behold, keep, know, mark, find, and watch.

4. How are nouns and verbs inflected? Which of the parts of speech are not inflected?

Nouns are inflected for gender, number, and case. Verbs are inflected for voice, mood, tense, number, and person.

Prepositions, conjunctions, and interjections have no inflections.

Geography.

(Answer two questions, including the first.)

1. Draw a map of British America, *or* of Ireland, giving chief physical features.

2. Name the provinces included in the Dominion of Canada and their chief towns, and give particulars of any three of these towns.

The Dominion of Canada embraces the following seven provinces:—

(1) Nova Scotia—Chief towns: Halifax; Sydney, in Cape Breton I.
(2) New Brunswick—St. John, Portland, Frederickton.
(3) Prince Edward Island—Charlotte Town.
(4) Quebec—Montreal, Quebec, Three Rivers, Hull, St. Henri.
(5) Ontario—Ottawa, Toronto, Hamilton, London, Kingston, Guelph.
(6) Manitoba—Winnipeg.
(7) British Columbia—Victoria, New Westminster.

Montreal, Quebec, and Toronto are the three largest towns of the Dominion.

Montreal is situated a thousand miles from the Atlantic on the north bank of the St. Lawrence. It is the commercial capital of the Dominion, and has a population of 150,000 of mixed French and British origin. It is a handsome, well-built city, and is the centre of the railway traffic, as well as the chief centre of the ocean traffic. The Victoria Bridge, two miles in length, across the St. Lawrence, is one of the chief objects of interest.

Quebec has a population of 65,000, and occupies a very commanding situation on a lofty eminence on the north bank of the St. Lawrence. It is the seat of the provincial government, has a spacious harbour, and does a good trade. Historically, it has many associations, and its surroundings are as beautiful as those of any city in the world.

Toronto, on Lake Ontario, is the second largest city of the Dominion, and has 100,000 inhabitants. It has a considerable grain and lumber trade, and is a great railway centre. Its streets are well laid out, and the surrounding country is rich and fertile.

3. Name the chief rivers, lakes, and mountains of Ireland and Scotland.

SCOTLAND:—*Rivers:* Clyde, Forth, Tweed, Tay, Dee, Don, Spey, N. and S. Esk, Ness, Annan, Nith, Ayr, Irvine.

Lakes: Lomond, Katrine, Earn, Tay, Rannoch, Awe, Loggan, Lochy, Oich, Ness, Shin, Shiel, Maree, Ken, Leven.

Mountains: N. Highlands (with Bens Wyvis, Attow, Derg, and More); Grampians (with Bens Nevis, Lawers, More, Venue, Lomond, MacDhui, Cruachan; and Schiehallion, Cairntoul, Cairngorm, and Lochnagar); Lowthers, Pentland, Lammermuir, Ochil, and Sidlaw Hills.

IRELAND:—*Rivers:* Shannon, Bandon, Lee, Blackwater, Suir, Barrow, Slaney, Liffey, Boyne, Laggan, Bann, Foyle, Erne.

Lakes: Loughs Neagh, Allen, Ree, Derg, Erne, Conn, Mask, Corrib, Killarney.

Mountains: Mourne Mountains, Carntogher, Donegal, Croagh Patrick, Connemara, Wicklow, Slieve Bloom, Galtee, Knockmeledown, Kerry, McGillicuddy's Reeks.

History.

1. How was England divided after its Conquest by the Saxons?

England was divided into kingdoms, the several invaders founding eight kingdoms, two of which were ultimately united. The eight kingdoms were:—

(1) Kent, founded by Hengist in 457.
(2) South Saxony, by Ella in 490.
(3) Wessex, or West Saxony, by Cerdic in 519.
(4) Essex, or East Saxony, by Ercemwin in 527.
(5) East Anglia, by Uffa in 575.
(6) Deira, in 547 } These were united in 617, and called
(7) Bernicia, in 547 } Northumbria.
(8) Mercia, by Cridda, in 582.

2. Give some account of the subjugation of England by the Danes, and a table of the Danish kings.

The Danes were of Scandinavian origin, and came principally from Denmark, Sweden, and Norway. They were enemies of the Saxons on account of the religious defection of the latter, and ravaged the English coasts first in 787. They were defeated by Egbert at Hengestsdun, in Cornwall, in 835, but were very troublesome in later reigns, especially Alfred's. Alfred defeated them (878) at Ethandune, in Somerset, although he had been beaten previously at Wilton. Ethelred the Unready bought them off with money raised by the *Danegelt*, and then massacred many in 1002. Sweyn then came and conquered the country. The Danish kings were—

Sweyn	...	...	1013—1016
Canute	...	...	1016—1035
Harold	...	...	1035—1040
Hardicanute	...	...	1040—1042

3. How was justice administered under the Saxons?

Courts were established in various parts of the country, and bargains of large amounts were ratified at these courts as well as criminals tried. Prices were set on the lives of the Saxons, and in case of murder, the accused paid the price or his life. Slaves were imprisoned or whipped, and theft was punished by death or mutilation. Accused persons could clear themselves by swearing their innocence in the presence of witnesses or by ordeal.

Composition.

Write from memory the substance of the following passage after being read to you once:—

In a war with France, an English drummer-boy, not more than fifteen years of age, having wandered from his camp too near the French lines, was seized and carried before the French commander. On being asked who he was, he said, 'A drummer in the English service.' This not being credited, a drum was sent for, and he was desired to beat a couple of marches, which he quickly did. The Frenchman's suspicion, however, not being quite removed, the boy was told to beat a retreat. 'A retreat, sir?' said the youth; 'I do not know what that is.' This answer so pleased the general that he released the boy, and wrote a letter to his commander commending his spirited behaviour.

Music.

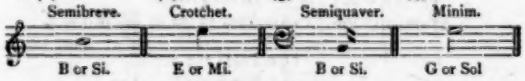
OLD NOTATION.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write above each of the following notes its value-name (crotchet, &c.), and below each its pitch-name (C, D, or Do, Re, &c.):—

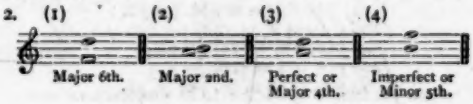
1. (1) Semibreve. (2) Crotchet. (3) Semiquaver. (4) Minim.



B or Si. E or Mi. B or Si. G or Sol

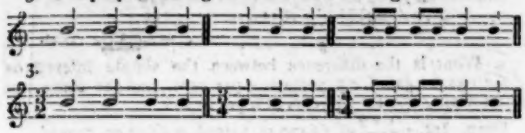
2. Write below each of the following intervals its name (major second, &c.):—

2. (1) (2) (3) (4)



Major 6th. Major 2nd. Perfect or Major 4th. Imperfect or Minor 3rd.

3. Add proper time-signatures to the following :—



3.

TONIC SOL-FA NOTATION.

1. Re-write the following an octave higher, halving the value of each note :—

$|s_1 :-|m :-|r :-|f :-|l_1 :-|s_1 :-|s :-|-:-|-:-\|$

1. $|s \;\; :m' \;\; |r' \;\; :f' \;\; |l \;\; :s \;\; |s' \;\; :- \;\; \|$

2. Name the following intervals :—(1) *fah* to *ray*^{1}; (2) *soh* to *lah*; (3) *soh* to *doh*; (4) *te* to *fah*^{1}.

2. (1) Major sixth; (2) major second; (3) perfect or major fourth; (4) imperfect or minor fifth.

3. What do you understand by "Key B" or "Key E" at the beginning of a tune?

3. That the particular sound called B or E is to be the tonic of the scale in which the music is written, and be called *doh*.

SECOND YEAR.

Pupil Teachers at end of Second Year.

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

1. If two straight lines cut one another, the vertical, or opposite angles are equal to one another.

Write the corollaries to this proposition.

Euclid, Book I., Prop. 15.

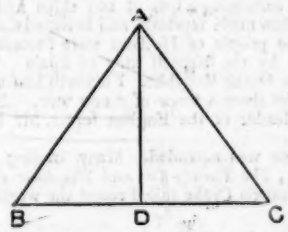
Cor. I. From this it is manifest that if two straight lines cut one another, the angles which they make at the point where they cut are together equal to four right angles.

Cor. II. Consequently, that all the angles made by any number of lines meeting at a point are together equal to four right angles.

2. At a given point in a given straight line to make a rectilineal angle equal to a given rectilineal angle.

Euclid, Book I., Prop. 23.

3. Show that the line which bisects the vertical angle of an isosceles triangle also bisects the base at right angles.



Let ABC be an isosceles triangle having side AB = side AC; and let the ∠ BAC be bisected by straight line AD meeting BC in D.

Then BC is bisected at right ∠'s by AD.

∵ in two △'s BAD, CAD, AB = AC and AD is common;

∴ two sides BA, AD = two sides CA, AD, each to each,

And the ∠ BAD = ∠ CAD (Hyp.);

∴ base BD = base CD (I. 4),

And remg. ∠'s = remg. ∠'s, each to each.

∴ ∠ BDA = ∠ CDA; and they are adjacent ∠'s.

∴ (Def. 10) they are right ∠'s.

Wherefore BC is bisected at right ∠'s by AD.—Q. E. D.

Arithmetic.

FEMALES.

1. Reduce the following fraction to its simplest form :—

$$\frac{7\frac{1}{2} \times \frac{1}{3} \text{ of } \frac{1}{3}}{13\frac{1}{12} - 12\frac{1}{2}}.$$

$$\frac{7\frac{1}{2} \times \frac{1}{3} \text{ of } \frac{1}{3}}{13\frac{1}{12} - 12\frac{1}{2}}$$

$$= \frac{\frac{15}{2} \times \frac{4}{157}}{1\left(\frac{1}{12} - \frac{1}{2}\right)}$$

$$= \frac{\frac{3}{1}}{1\left(\frac{15-28}{36}\right)}$$

$$= \frac{3}{1} \times \frac{36}{13}$$

$$= \frac{36}{13}$$

$$= 1\underline{\frac{23}{13}}. \quad \text{Ans.}$$

2. Find the sum of $\frac{1}{3}$ of a guinea, $\frac{3}{16}$ of a £, and $\frac{1}{2}$ of a crown, and take the amount from a guinea and a half.

			s.	d.
$\frac{1}{3}$ gui.	$= \frac{1}{3} \times \frac{21}{1} = \frac{21}{3}$s.	$=$	9	4
$\frac{3}{16}$ £	$= \frac{3}{16} \times \frac{20}{1} = \frac{15}{4}$	$=$	6	3
$\frac{1}{2}$ cr.	$= \frac{1}{2} \times \frac{5}{1} = \frac{5}{2}$	$=$	1	$10\frac{1}{2}$
			17	$5\frac{1}{2}$

$1\frac{1}{2}$ gui. − 17s. $5\frac{1}{2}$d.

= £1 11s. 6d. − 17s. $5\frac{1}{2}$d. = 14s. $0\frac{1}{2}$d. Ans.

3. What decimal is equal to $\cfrac{2}{10+\cfrac{1}{2+\frac{1}{10}}}$

$$\frac{2}{10+\frac{1}{2+\frac{1}{10}}}$$

$$= \frac{2}{10+\frac{10}{21}}$$

$$= \frac{42}{220}$$

$$= \frac{21}{110}$$

$$= \underline{.190625}. \quad \text{Ans.}$$

4. What fraction of a week is the difference between $7\frac{1}{2}$ hr. and $\frac{3}{10}$ of a day?

$$\frac{\frac{3}{10} \text{ day} - 7\frac{1}{2} \text{ hr.}}{7 \text{ days}}$$

$$= \frac{\frac{3 \times 24}{10} - 7\frac{1}{2}}{7 \times 24}$$

$$= \frac{\frac{1}{2} - \frac{1}{2}}{168}$$

$$= \frac{1}{10} \times \frac{1}{168}$$

$$= \underline{\frac{1}{1680}}. \quad \text{Ans.}$$

Grammar.

MALES AND FEMALES.

1. '*Regions* Cæsar *never knew*
Thy posterity *shall sway*;
Where his eagles never flew,
None invincible as they.'—COWPER.

Analyse the above passage, and parse the words in italics.

ANALYSIS.

Sentence.	Kind of Sentence.	Connective.	Subject.	Predicate.	Object.	Extension.
(*a*) Thy posterity shall sway regions	Princ. Sent.		Thy posterity	shall sway	regions	
(*b*) Cæsar never knew [which]	Adj. Sent. to *regions* in *a*.	In *rel. pro.* und.	Cæsar	knew	[which]	never (time
(*c*) Where his eagles never flew	Adv. Sent. to *c*.	where	his eagles	flew		never (time)
(*d*) None [shall be] invincible	Princ. Sent.		none	[shall be] invincible		
(*e*) as they [shall be invincible]	Adv. Sent. (manner) to *d*.	as	they	[shall be invincible]		

Regions—com. noun, neut., plur., obj., gov. by *shall sway*.
never—adv. of time, qualg. *knew*.
knew—irreg. trans. verb, act., ind., past, 3rd, agreeing with its nom. *Cæsar*.
shall—aux. verb to *sway*, indicating fut. tense.
sway—reg. trans. verb, act., inf., pres., gov. by *shall*.
shall sway—reg. trans. verb, act., ind. fut., 3rd, plur., agreeing with its nom. *posterity*.
where—advl. conj., joining the sents. 'None shall be as invincible as they,' and 'His eagles never flew.'
none—numl. adj., qual. *people* und., *or* indef. per. pro., nom. to *shall be*.
invincible—adj. of quality, qualg. *people*.
as—cop. conj., joining the sents. 'None shall be invincible,' and 'They shall be invincible.'
they—per. pro., masc., plur., 3rd, nom. to *shall be*, und.

2. Explain the prefixes in the following words:—Enterprise, allude, circulate, demure, digest, escape, pardon, treason.
In enterprise (Fr.) *enter*—into.
,, allude (L.) *al*—to
,, circulate (L.) *circa*—round about.
,, demure (L.) *de*—down from.
,, digest (L.) *di*—apart, in two.
,, escape (L.) *e*—out of.
,, pardon (L. through Fr.) *par*—through.
,, treason (L. through Fr.) *trea*—beyond.

3. Paraphrase the passage given for analysis :—
Thy descendants shall rule over countries whose existence was unknown to Cæsar, and thy successors shall be supreme in districts where the standards of Rome have never been seen.

Geography.

Answer two questions, one of which must be No. 1.

1. Draw a map of Turkey and Greece, showing the chief physical and political features, and marking the changes which have lately been made in the extent of the territory of each.

2. What are the chief exports of Canada and New Zealand?
Canada exports the produce of her fields, forests, fisheries, and mines; cattle, wheat, maize, and other cereals; timber (maple, pine, spruce, cedar, etc.); cod; copper; tinned meats.
New Zealand exports wool, gold, hides, timber, wheat, and other farm produce.

3. What countries supply us with cotton, corn, currants, gold, silver, and copper?
Cotton from United States, India, Egypt, British Burmah, Queensland.
Corn from Russia, United States, Canada, India, Egypt.
Currants from Greece and Turkey in Asia.
Gold from Australia, New Zealand, California, Chili, Siberia.
Silver from Austria, Chili, Siberia, Mexico.
Copper from Australia, South Africa.

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

(One hour allowed for the Exercise in Needlework.)

Arithmetic.

MALES.

1. Consols fell $\frac{1}{4}$ during the course of a day; how much would a person lose who invested £4,500 in the morning at $99\frac{3}{4}$, and sold in the afternoon at the reduced rate, brokerage being reckoned on both transactions?

Buying price $= 99\frac{3}{4} + \frac{1}{4} = 99\frac{1}{2}$.
Selling price $= 99\frac{1}{2} - (\frac{1}{4} + \frac{1}{4}) = 98\frac{3}{4}$.
$\therefore$ Loss on each $99\frac{3}{4}$ expended $= 1$.

£ £ £
$99\frac{3}{4} : 4{,}500 :: 1 : x$
$= £45\ 1s.\ 1\frac{1}{2}d.$ Ans.

2. What is the true discount on a bill for £1831 12s., drawn on the 12th September at 5 mos., and discounted January 13th at 4 per cent.?
Bill due on Feb. 15th. Discount for 33 days.

Interest on £100 for 33 dys. $= \frac{33}{365} \times 4 = £\frac{132}{365}$
$\therefore$ £$100\frac{132}{365}$: £1831 12s. :: £$\frac{132}{365}$: x
$= £6\ 12s.$ Ans.

3. What is the difference between the simple interest on £6470 4s. 11·52d. for 5 years at 2 per cent., and the compound interest on £650 for 2½ years at 6 per cent.?

Simp. Int. $= \frac{5 \times 2}{100}$ of £6470 4s. 11·52d. $=$ £647 0s. 5·952d.

Comp. Int.
650
1·06
3900
6500
689
1·06
4134
6890
730·34
1·03
219102
730340
752·2502
20
5·0040
12
·048.

£	s.	d.	
647	0	5·952	= S. I.
102	5	0·048	= C. I.
544	15	5·904	= Diff.

Ans.

4. A tea dealer buys 56 lbs. tea at 4s. 2d. per lb., and mixes it with another kind worth 2s. 11d.; he sells the mixture at 3s. 8d. per lb., and gains 20 per cent. on his outlay; how much of the second kind did he use?

s. d.
Value of mixture = 120 : 100 :: 3s. 8d. : 3 0⅔
Loss in price per lb. on first kind = 4s. 2d. − 3s. 0⅔d. = 1 1⅓
Gain in price on second kind = 3s. 0⅔d. − 2s. 11d. = 1⅓
No. of lbs. of latter to equal former $= \frac{1s.\ 1\frac{1}{3}d.}{1\frac{1}{3}d.} = 8$
Total lbs. of second kind $= 56 \times 8 = 448$. Ans.

History.

MALES AND FEMALES.

1. State what you know of the relationship of England with foreign countries in the reign of Elizabeth.
Philip of Spain was annoyed at being refused by Elizabeth, and as English sailors had robbed his treasure-ships on their way from America, and part of the money used in helping his rebellious subjects in the Netherlands, when Mary, Queen of Scots, his co-religionist, was executed, he was furnished with an ample pretext for the invasion of England. The *Invincible Armada* was sent for the purpose, but was defeated and destroyed, Spain sustaining a loss of 100 ships and 20,000 men. The English then made reprisals, and besieged Cadiz.
Many of the people of Holland were Protestants, and were cruelly treated by the bigoted king of Spain. They revolted, and formed the Dutch Republic. Elizabeth lent money to them, and in 1584 sent them a force of 6,000 men. At the battle of Zutphen, the leader of the English forces, Sir Philip Sydney, was killed.
Foreign trade was extended. Many trading companies, as *The Baltic Co.*, *The Turkey Co.*, and *The East India Co.*, were formed. Sir Francis Drake sailed round the world, and Virginia was founded.

2. What extension of liberties was granted by Stephen to secure the favour of the barons and people?
He allowed the barons to build and fortify castles, and promised to restore to the nobility all the forests which had been forcibly taken from them during the previous reign. He abolished the tax of *Danegelt*, and said that the laws of Edward the Confessor should be observed. He also promised to fill up all vacant benefices immediately, and not to interfere with their incomes any more.

3. Trace the descent of Henry VII. from Edward the Second, and, if you can, show his connection with the Princes of Wales.
Henry VII. was the son of Edmund Tudor, Earl of Richmond, and Margaret, daughter of John, Duke of Somerset, who was himself the son of John, Earl of Somerset, the eldest son of John of Gaunt. John of Gaunt was the fourth son of Edward III., and grandson of Edward II.
Lewellyn, the last prince of North Wales, had a daughter, Catherine, who married Philip ap Ivor, Lord of Cardigan. They

had issue Eleanor, who married Llewellyn, Lord of South Wales. Their daughter Margaret, married Meredith Tudor, whose son, Owen Tudor, married the widow of Henry V. Edmund Tudor was their son.

Teaching.

Name some of the chief difficulties you have met with in teaching spelling, and state the means you have adopted to ensure correctness in that subject.

The chief difficulties of spelling English consist in the number of silent letters in many of the words, in the various sounds of the vowels, and in the similarity of sound of different combinations of vowels.

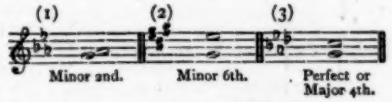
Familiarity with the words and their meanings by varied reading-lessons; the writing of lists of similar words on slate from dictated spelling or from written words on black-board; dictation exercises with careful correction of mistakes, and constant oral spelling are the best means of securing correct spelling.

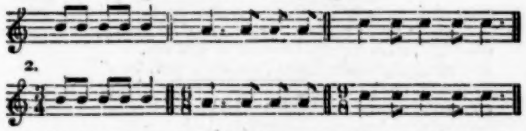
Music.

A quarter of an hour allowed for this paper.

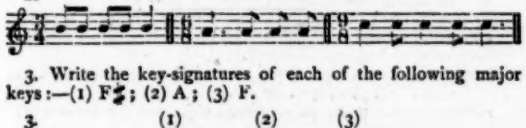
(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write below each of the following intervals its name (major third, &c.):—

1. (1) (2) (3)

2. Add time-signatures to the following:—



2.



3. Write the key-signatures of each of the following major keys:—(1) F♯; (2) A; (3) F.

3. (1) (2) (3)

TONIC SOL-FA NOTATION.

1. Write the names of the following intervals:—(1) *te*, to *doh*; (2) *te*, to *fah*; (3) *te*, to *me*.

1. (1) Minor second; (2) imperfect or minor fifth; (3) major or perfect fourth.

2. What is the mental effect of (1) *doh*; (2) *soh*; (3) *ray*?

2. (1) Firm, steady; (2) bold; (3) rousing or hopeful.

3. Write the forms for three, four, and six-pulse measures; and a six-pulse tone using three-pulse measures.

3. Three | : : ‖

Four | : | : ‖

Six | : : | : : ‖

| d :— :— |— :— :— ‖

THIRD YEAR.

Pupil Teachers at end of Third Year.

FIRST PAPER.

Three hours and a half allowed.

(All generally understood abbreviations for words may be used.)

Answer two questions, including No. 3, if you can.

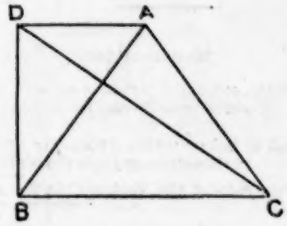
1. Equal triangles on equal bases in the same straight line, and on the same side of it, are between the same parallels.

Euclid, Book I., Prop. 40.

2. To describe a parallelogram equal to a given rectilineal figure, and having an angle equal to a given rectilineal angle.

Euclid, Book I., Prop. 45.

3. Describe a right-angled triangle equal to a given triangle.



Let ABC be the given triangle. It is reqd. to describe a right-angled △ equal to it. From the point B in the straight line BC draw BD at right angles to BC (I., 11), and through the point A draw AD parallel to BC (I., 31). Join DC.

DBC shall be the △ reqd.

Because the two △'s DBC, ABC are upon the same base BC, and between the same parallels DA, BC, they are equal to one another (I., 37). And the △ DBC contains the right ∠ DBC (const.) ∴ a right-angled △ DBC has been drawn equal to a given △ ABC.

Algebra.

(Answer two Questions, including No. 3, if you can.)

1. Simplify $\left(\frac{a-b}{a+b}+\frac{a+b}{a-b}\right) \div \left(\frac{a^2-b^2}{a^2+b^2}+\frac{a^2+b^2}{a^2-b^2}\right)$.

$$\left(\frac{a-b}{a+b}+\frac{a+b}{a-b}\right) \div \left(\frac{a^2-b^2}{a^2+b^2}+\frac{a^2+b^2}{a^2-b^2}\right)$$

$$= \frac{(a-b)^2+(a+b)^2}{a^2-b^2} \div \frac{(a^2-b^2)^2+(a^2+b^2)^2}{(a^2+b^2)(a^2-b^2)}$$

$$= \frac{2(a^2+b^2)}{a^2-b^2} \times \frac{(a^2+b^2)(a^2-b^2)}{2(a^4+b^4)}$$

$$= \underline{\frac{(a^2+b^2)^2}{a^4+b^4}}. \quad \text{Ans.}$$

2. Give clearly the rule for finding the Least Common Multiple of two simple and two compound algebraic expressions.

Find the L. C. M. of x^3-7x-6; $x^3+8x^2+17x+10$.

Rule for L. C. M. of two simple expressions:—

Find by Arithmetic the L. C. M. of the numerical co-efficients; after this number place every letter which is found in the expressions, giving to each the greatest index which either of the expressions contains;

e.g., L. C. M. of $6x^3y^2$ and $8x^2z^4 = 24x^3y^2z^4$.

Rule for L. C. M. of two compound expressions:—

Divide the expressions by their G. C. M., and multiply the quotients and the G. C. M. together.

$$x^3-7x-6,\ x^3+8x^2+17x+10$$
$$= (x+1)(x+2)(x-3),\ (x+1)(x+2)(x+5);$$
$$\therefore \text{G. C. M.} = (x+1)(x+2);$$
$$\therefore \text{L. C. M.} = \underline{(x+1)(x+2)(x+5)(x-3)}. \quad \text{Ans.}$$

3. Solve the following equations:—

(*a*) $\frac{x}{a}-\frac{dx}{c}+3ab=1.$

(*b*) $\frac{x+ax-bx}{a-b}=\frac{ex-d}{c}.$

(*a*) $\frac{x}{a}-\frac{dx}{c}+3ab=1$

$$cx-adx+3a^2bc=ac$$
$$x(c-ad)=ac-3a^2bc$$
$$x=\underline{\frac{ac-3a^2bc}{c-ad}}. \quad \text{Ans.}$$

(*b*) $\frac{x+ax-bx}{a-b}=\frac{cx-d}{c}$

$c(x+ax-bx)=acx-ad-bcx+bd$

$cx+acx-bcx-acx+bcx=d(b-a)$

$cx=d(b-a)$

$x=\frac{d(b-a)}{c}$. Ans.

Mensuration.

A piece of ground contained ·27104 of an acre, and its length was 176 links. Find its breadth and its value at 1½d. a square link.

Area of ground in links = ·27104 × 100,000 = 27104 links

∴ Breadth = 27104 ÷ 176 = 154 links. Ans.

27104 sq. links at 1½d. each = £169 8s. Ans.

Arithmetic.

FEMALES.

1. A traveller could only get along at the rate of 1½ miles in 1 hr. 5′ 6″; how long would he be in going 13 miles 880 yds. at the same rate?

mls. mls. hr.
1½ : 13¼ :: 1 5′ 6″ : *x*

= 9 45 54. Ans.

2. Add 749·26, 37·23, 7·72, ·297, 32·41, 74·0367, 12·75, and 3·973. Correct to 6 places of decimals.

749·2666666
37·2333333
7·7272727
·2977777
32·4111111
74·0367
12·7575757
3·9739739
917·706411. Ans.

3. Find the value of ·5 of 1s. 10½d. + ⅙ of a guinea + $\frac{3}{15}$ of a £ + $\frac{4}{15}$ of a crown + ·75 of a sovereign + £8 12s. 6d.

		£	s.	d.
·5 of 1s. 10½d.	= ½ of 1s. 10½d.	= 0	0	11¼
⅙ of a guinea	= ⅙ × 21s. = 3½s.	= 0	16	4
$\frac{3}{15}$ of £1	= $\frac{3}{15}$ × 20 = 4	= 0	2	8
$\frac{4}{15}$ of 1 crown	= $\frac{4}{15}$ × 5 = 1⅓	= 0	1	6¾
·75 of £1	= ¾ × 20	= 0	15	0
£8 12s. 6d.		= 8	12	6
		£10	9	0 Ans.

4. What decimal of £3 is ·123 of 4s. 7½d. + ·129 of £·625 + ·01 of £1 13s. 9d.?

(Find to four places of decimals.)

·123 of 4s. 7½d. = $\frac{123}{1000}$ × $\frac{111}{24}$ = $\frac{4563}{8000}$d.

·129 of £·625 = $\frac{129-12}{900}$ × ⅛ = $\frac{117}{900}$ × ⅛ = $\frac{13}{100}$£ = $\frac{312}{25}$d.

·01 of £1 13s. 9d. = $\frac{1}{100}$ × $\frac{413}{30}$ = $\frac{413}{3000}$d.

$\frac{\frac{41}{2}+\frac{39}{3}+\frac{9}{2}}{3\times240}$

$=\frac{41+117+27}{6}$

$=\frac{185}{720}$

$=\frac{185}{4320}\times\frac{1}{720}$

$=\frac{4563}{8000}$

= ·0428. Ans.

Grammar.

MALES AND FEMALES.

1. Analyse the following, parsing the words in italics:—

Shall *one of us*,
That struck the foremost man of *all* this *world*
But for *supporting robbers*, shall we now
Contaminate our fingers with base bribes,
And sell the mighty *space* of our large honours
For so much trash *as may be grasped* thus?

SHAKESPEARE.

(*a*) ANALYSIS.

Sentence.	Kind of Sentence.	Con.	Subj.	Predicate.	Object.	Exten.
(*a*) Shall one of us [contaminate our fingers]	Principal Sentence.		One of us	shall [contaminate]	our fingers	
(*b*) That struck the foremost man of all his time, but for supporting robbers	Adj. Sent. to *us* in *a*		that	struck	the foremost man of all his time	but for supporting robbers (reason)
(*c*) Shall we now contaminate our fingers with base bribes	Prin. Sent. co-ord. with *a*.		we	shall contaminate	our fingers (dir.) with base bribes (indir.)	
(*d*) And sell the mighty space of our large honours for so much trash	Prin. Sent. co-ord. with *a* and *c*.	And	[we]	[shall] sell	the mighty space of our large honours (dir.) for so much trash (ind.)	
(*e*) As may be grasped thus	Adv. Sent. to *d*.	as	[it]	may be grasped		thus (manner

(*b*) *One*—def. num. adj., qualg. *person* und., *or* indef. pers. pro., sing., 3rd, masc., nom. to *shall contaminate*.
of—prep., showing rel. between *us* and *one*.
us—pers. pro., masc., plur., 1st, obj., gov. by *of*.
that—rel. pro., masc., plur., 1st, nom. to *struck*.
all—adj. of quantity, qual. *world*.
but—adv. of deg., qual. *struck*.
supporting—pres. part., used as verbal or abs. noun, neut., sing., 3rd, obj., gov. by *for*.
robbers—com. noun, masc., plur., obj., gov. by trans. part. *supporting*.
space—abs. noun, neut., sing., obj., gov. by *sell*.
as—cop. conj., joining the sents. 'shall we sell, etc.,' and 'it may be grasped thus.'
may—aux. verb to *be grasped*, indicating pot. mood.
be—aux. verb to *grasped*, indicating pass. voice.
grasped—past part. of *to grasp*, referring to *it*.
may be grasped—reg. trans. verb, pass. voice, pot., pres., 3rd, sing., agreeing with its nom. *it* und.

2. Paraphrase the above passage.

Can it be possible that either one or all of us should, for a paltry sum which can be held in the hand, tarnish our reputation for uprightness and be guilty of accepting bribes, when it is remembered that merely for befriending persons accused of theft we killed the noblest man this world ever knew?

3. Give examples of the way in which adjectives may be formed from nouns.

Adjectives are principally formed from nouns by the use of the following affixes:—al, ac, en, less, ly, ful, ish, some, and y. Illustrations:—formal, demoniac, wooden, homeless, worldly, hurtful, heathenish, handsome, healthy.

4. How may English words be known from foreign words?

In several ways:—

(*a*) By their length—nearly all monosyllabic words being English.

(*b*) By the grammatical use made of them—nearly all pronouns, prepositions, conjunctions, numerals, and demonstrative adjectives are English.

(*c*) By their spelling—wh, kn, gn, th, sh, ough, are combinations of letters peculiar to English.

(*d*) By their meaning—all common objects and words of every day life are English.

(*e*) By their formation—English derivatives are usually made up of prefixes, affixes, and simple English words without any change.

Geography.

1. Draw a map of Africa south of the Equator, marking the chief physical and political features.

2. Describe the surface of Asia.

Asia has its greatest length from N.E. to S.W., and its axis of elevated land is in the same direction. Starting from the lofty plateau N.W. of the Himalayas, near the centre of the continent, the mountains stretch to the utmost limits of the continent. Westwards there are the Hindoo Koosh, Bolor Tagh, Taurus, Anti-Taurus, and Caucasus ranges, and to the east the Himalayas, Kuen Lun, Thian Shan, Altai, and Yablonnoi mountains. The great slope of this extensive range of mountains is towards the north, and the great plain of Siberia is watered by the three large rivers Obi, Yenisei, and Lena. The western district consists mainly of lofty plateaus, and Hindostan, south of the plain of the Ganges, is also a tableland. Wide valleys between the ranges of mountains are watered by the Hoangho, Yang-tse-kiang in the east, and the Ganges, Indus, and Euphrates and Tigris in the south.

3. Give some account of the climate of Africa.

Africa is the least rainy of the four large divisions of the globe, and being situated chiefly within the tropics it is hotter than either of the other divisions. The highlands are generally near the coast, and the moisture which is carried to the country from the sea is either precipitated close to the ocean or is carried right across the continent without precipitation. The heat of the central portion of the continent, especially in the north, is so great that rain seldom or never falls, and consequently the greater portion is desert and uninhabitable. The southern half of the continent is not so broad, and a considerable range of mountains near the Equator serves to condense the vapour, and becomes the source of the great Nile and Congo. The soil of South Central Africa is rich, and the uncertainty of water is the only great drawback to the whole being very suitable for Europeans.

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

One hour allowed for the exercise in Needlework.

Arithmetic.

MALES.

1. What is the meaning of *Present Worth?* State clearly the difference between *true discount* and *commercial discount*, and find the present worth of £151 17s. 6d. due in 4 years at 5½ per cent. per annum.

Present Worth is the amount of a debt after the discount has been deducted, and is such a sum as being put out at interest for the given time and at the given rate would, with the interest, equal the debt.

True Discount is the interest of the present worth of a debt.

Commercial Discount is the interest on the debt itself.

Int. of £100 = 4 × 5½ = 21½

∴ 121½ : 151⅞ :: 100 : P.W.

= £125. Ans.

2. A bankrupt has good debts to the amount of £456 18s. 3d., and he receives 4s., 5s., and 10s. in the £ respectively on the following: £360 7s. 6d., £120 13s., and £21 4s. If he owes £4558, what percentage of their money will his creditors lose?

His assets are :—	Good debts... £456	18	3
£360 7s. 6d. at 4s. in £ =	72	1	6
£120 13s. at 5s. " =	30	3	3
£21 4s. at 10s. " =	10	12	0
Total assets =	569	15	0

£4558 − £569 15s. = £3988 5s.

∴ £4558 : £100 :: £3988 5s. : 87½. Ans.

3. Extract the square roots of 32½ and of ·00011236.

$\sqrt{32\frac{1}{2}} = \sqrt{\frac{2^2}{2^2}\frac{1}{2}} = \frac{1}{2}\sqrt{5} = 5\cdot6$. Ans.

·00011236(·0106. Ans.

1

206) 1236

1236

4. What is the half-yearly dividend of a sum of money equal to the present worth of £30,192 due 6 months hence at 4 per cent. invested in the 3 per cents. at 92½?

P.W. = £102 : £30,192 :: £100 : £29,600

Div. $= \frac{29600 \times 3}{92\frac{1}{2}} =$ £960. Ans.

History.

MALES AND FEMALES.

1. Write a table of the principal battles fought between the King and Parliament's forces from 1642 to 1651, and write a short sketch of Hampden or Cromwell up to this time.

The principal engagements with their results and dates were as follows :—

Royalist Victories—

Edgehill and Chalgrove Field	1642
Atherton Moor, Lansdown, and Firs t Battle of Newbury	1643
Cropredy Bridge...	1644

Parliamentary Victories—

Second Battle of Newbury	1644
Marston Moor	1644
Naseby and Philiphaugh	1645
Dunbar	1650
Worcester...	1651

John Hampden was a gentleman of Buckinghamshire, and was born in 1594. While a youth he mixed freely in all kinds of sport and company, but at twenty-five he became serious and strict in his demeanour. He entered Parliament as member for Wendover, and afterwards for Buckinghamshire. He distinguished himself by refusing to lend money on compulsion to the king, and afterwards by his opposition to the illegal levying of ship-money. He was one of the five members whom Charles attempted to arrest for high treason, and when it was necessary to resist the king by force of arms he raised a regiment in his own county. During the campaign which followed he assisted in checking the king's forces at Brentford, and at Chalgrove field he was killed A.D. 1642.

2. What were the causes which led to the Revolution of 1688?

The great design of James II. was to completely restore Roman Catholic worship into Great Britain. He began by violating the Test Acts, appointing Roman Catholics to positions in the army. A Papal nuncio was entertained at Whitehall, and a Jesuit became James's chief adviser. The Universities were attacked, and a Romish bishop placed over Magdalen College. Then came the Declaration of Indulgence, for refusing to read which the seven bishops were tried. On their acquittal, James determined to use force to obtain his will, and brought over several regiments from Ireland for the purpose of intimidating the English. The leading nobles of England then invited the Prince of Orange to come and defend the liberties of England and the Protestant religion. James's flight and William's election as king were the results.

3. Give dates to the chief events of English history from 1760 to 1820.

Close of the Seven Years' War and Treaty of Paris	1763
Prosecution of John Wilkes	1763
Passing of the Stamp Act	1765
American War of Independence ...	1775—1782
Treaty of Versailles	1783
Gordon Riots	1780
Trial of Warren Hastings	1788
Mutinies at Spithead and the Nore... ...	1797
French Revolution—Naval and Land Battles	1793—1808
Peninsular War	1808—1815
Battle of Waterloo	1815

Teaching.

Write notes of a lesson on 'Manufacture of Cheese.

I. *Composition of Milk and Cheese.* If milk becomes sour, separates into two parts, *curds* and *whey*. The former becomes the main substance of cheese.

II. *Method of Manufacture.* Milk warmed and mixed with *rennet* (explain). Curd next removed and placed in coarse cloth in vats with holes drilled in. Placed in cheese-press to free from

whey. Turned several times during following days; placed in salting-tub where it is covered with brine for several days. Rubbed daily with salt, and after 10 or 12 days, removed to cheese-room.

III. *Locality of Manufacture.*—All over England. Best in Cheshire, Gloucester, Wilts, and Somerset. 'Stilton' is made in Leicestershire. Great quantities are now brought from America and Holland.

IV. *Kinds.* Single, double (according to thickness), Stilton, Cheddar, quality according to milk from which made.

Music.

A quarter of an hour allowed for this paper.

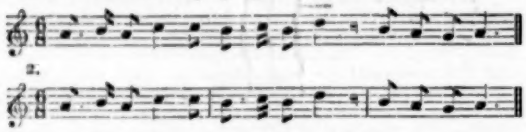
(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write below each of the following intervals its name (minor third, &c.):—

1. (1) (2) (3)

Augmented or Pluperfect 5th. Perfect 4th. Augmented 3rd.

2. Add bars in their proper places to the following:—



2.

3. State briefly the meaning of (1) *Andante*; (2) *rallentando*; (3) *pianissimo*.

3. (1) Neither fast nor slow; (2) getting gradually slower; (3) very soft.

TONIC SOL-FA NOTATION.

1. Write perfect fourths above:—(1) *fah*; (2) *me*; (3) *te*.

1. (1) *ta*; (2) *lah*; (3) *me*.

2. Re-write the following in four-pulse measure, doubling the value of every note and rest:—

|s	.f	:m	.r	|d	:	.d'	|d	:	‖		

2.

|s	:f	|m	:-.r	|d	:—	|	:d	|d	:—	|	: ‖

3. What is the meaning of (1) *Andante*; (2) *rallentando*; (3) *pianissimo*?

3. (1) Neither fast nor slow; (2) getting gradually slower; (3) very soft.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year.

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

[All generally understood abbreviations for words may be used.]

Answer two Questions, including No. 3, if you can.

1. If a straight line be divided into any two parts, the rectangles contained by the whole and each of the parts are together equal to the square on the whole line.

Euclid, Book II., Prop. 2.

2. To describe a square that shall be equal to a given rectilineal figure.

Euclid, Book II., Prop. 14.

3. Prove Euclid, Book II., Prop. 10, algebraically.

Let AB = $2x$ units: then AC or CB will contain x units.
Let BD contain y units.
Then AD will contain $2x+y$ units
And CD will contain $x+y$ units.
AD^2 is $\therefore (2x+y)^2 = 4x^2+4xy+y^2$.
To each add y^2 (sq. on BD.)
$\therefore (2x+y)^2+y^2 = 4x^2+4xy+2y^2$.
Again, $(x+y)^2 = x^2+2xy+y^2$.
Add x^2 to each (sq. on half line).
$\therefore (x+y)^2+x^2 = 2x^2+2xy+y^2$,
Doubling these equals,
$2(x+y)^2+2x^2 = 4x^2+4xy+2y^2$,
And it has been shown that
$(2x+y)^2+y^2 = 4x^2+4xy+y^2$;
$\therefore (2x+y)^2+y^2 = 2(x+y)^2+2x^2$.

Algebra.

(Answer two Questions.)

1. Find the value of $\left(1+\frac{1}{x}\right) \div \left(x-\frac{1}{x}\right) \times \left(1-\frac{1}{x}\right)^2$

$$\left(1+\frac{1}{x}\right) \div \left(x-\frac{1}{x}\right) \times \left(1-\frac{1}{x}\right)^2$$
$$= \frac{x+1}{x} \div \frac{x^2-1}{x} \times \left(\frac{x-1}{x}\right)^2$$
$$= \frac{x+1}{x} \times \frac{x}{x^2-1} \times \frac{x-1}{x} \times \frac{x-1}{x}$$
$$= \underline{\frac{x-1}{x^2}}. \quad \text{Ans.}$$

2. Solve the following equations:—

(1) $\frac{x}{a}+\frac{y}{b} = \frac{x}{b}-\frac{y}{a} = 1$

(2) $\frac{x+8}{4}+6y = 21$

$\frac{y+6}{3} = 23-5x$

(1) $\frac{x}{a}+\frac{y}{b} = \frac{x}{b}-\frac{y}{a} = 1$

$bx+ay = ab$ (I.)
$ax-by = ab$ (II.)

Mult. I. by b and II. by a, and add.

$b^2x+aby = ab^2$
$a^2x-aby = a^2b$
$x(a^2+b^2) = a^2b+ab^2$
$$x = \underline{\frac{a^2b+ab^2}{a^2+b^2}}. \quad \text{Ans}$$

Substitute value of x in I.

$$\frac{ab^2(a+b)}{a^2+b^2}+ay = ab$$
$$ay = ab-\frac{ab^2(a+b)}{a^2+b^2}$$
$$ay = \frac{ab(a^2+b^2)-ab^2(a+b)}{a^2+b^2}$$
$$ay = \frac{ab(a^2-ab)}{a^2+b^2}$$
$$y = \underline{\frac{ab(a-b)}{a^2+b^2}}. \quad \text{Ans.}$$

(2) $\frac{x+8}{4}+6y = 21$ (I.)
$\frac{y+6}{3} = 23-5x$ (II.)
$x+8+24y = 84$ (I.)
$y+6 = 69-15x$ (II.)
$x+24y = 76$ (I.)
$15x+y = 63$ (II.)

Mult. I. by 15.

$15x+360y = 1140$
$15x+y = 63$
$359y = 1077$
$$y = \underline{3}. \quad \text{Ans.}$$
$x+72 = 76$
$$x = \underline{4}. \quad \text{Ans.}$$

3. Give the rule for solving an adfected quadratic, and apply it to find the value of x in $\frac{x+2}{x-1}-\frac{4-x}{2x}=2\frac{1}{2}$.

Rule.—Reduce the equation to its simplest form: place all the powers of x on one side of the equation, and the known quantities on the other; to each side add half the coefficient of x squared; extract the square root of each side, and the two roots of the equation will be thus found.

$$\frac{x+2}{x-1}-\frac{4-x}{2x}=2\tfrac{1}{2}$$
$$6x^2+12x+3x^2-15x+12=14x^2-14x$$
$$-5x^2+11x=-12$$
$$x^2-1\tfrac{1}{2}x+(\tfrac{3}{4})^2=\tfrac{1}{8}+(\tfrac{3}{4})^2$$
$$x-\tfrac{3}{4}=\pm\tfrac{5}{4}$$
$$x=\underline{2}, \text{ or } -\tfrac{1}{2}. \text{ Ans.}$$

Mensuration.

A farmer gave to his labourers a sector of a circular field the diameter of which was 120 yards and the arc 60°, how much land did they receive?

Area of circle $=120^2\times\cdot7854$
$=11309\cdot76$ yds.
$\therefore$ 360 : 60 :: 11309·76 : 1884·96 yds. Ans.

Arithmetic.

FEMALES.

1. If 3½ per cent. be lost by selling flour at 1s. 8d. per stone, what was the cost price per cwt.?

1s. 8d. $\times 8=13$s. 4d. per cwt. S.P.
96½ : 100 :: 13s. 4d. : C.P.
$=13$s. $9\frac{23}{97}$d. Ans.

2. If two persons invested equal sums of money in the 4 and 4½ per cents. respectively, and got the same amount of interest, the price of the former being 75, what would be the price of the latter?

£100 in the 4 per cents. at 75 would produce
75 : 100 :: 4 : £5⅓ int.

An equal sum invested in the 4½ per cents. produces the same sum
$\therefore$ the price of 4½ per cents. will be
5⅓ : 4½ :: 100 : 79½. Ans.

3. What sum is that of which the interest for one year exceeds the discount on the same sum due a year hence at 5 per cent. by £1?

£100 in a year would produce £5 interest
$\therefore$ Discount on £105 for 1 year at 5 per cent. $=$ £5
And Int. on £105 for 1 year $=$ £5 5s.
Difference $=5$s.

£ £ £
$\therefore$ 5s. : 1 :: 105 : 420. Ans.

4. If the interest of £540 10s. for one year be 27s. 6d., what principal will yield the same sum in 2½ years?

2½ : 1 :: £540 10s. : £216 4s. Ans.

Grammar.

MALES AND FEMALES.

1. Analyse the following, parsing the words in italics:—

Who doth ambition *shun*,
And loves *to lie* i' the sun,
Seeking the food he eats,
And pleased with *what* he gets,
Come hither;
Here shall he see
No enemy
But winter and rough weather.

SHAKESPEARE.

ANALYSIS.

Sentence.	Kind of Sentence.	Connective.	Subject.	Predicate.	Object.	Extension.
(*a*) Who doth ambition shun	Adj. Sent. to *g*.		who	doth shun	ambition	
(*b*) And loves to lie i' the sun	Adj. Sent. to *g*.	And	[who]	loves	to lie i' the sun	
(*c*) Seeking the food	Adj. Sent. to *g*.		[who]	[is] seeking	the food	
(*d*) He eats	Adj. Sent. to *c*.		he	eats	[which]	
(*e*) And pleased with what	Adj. Sent. to *g*.	And	[who]	is pleased	with what (ind.)	
(*f*) He gets	Adj. Sent. to *e*		he	gets		
(*g*) Come hither	Prin. Sent.		[thou]	let	him (dir.) to come hither (ind.)	
(*h*) Here shall he see no enemy but winter and rough weather	Prin. Sent. co-ord. with *g*.		he	shall see	no enemy but winter and rough weather	here (place)

Who—rel. pro., com., sing., 3rd per., nom. to *doth shun*.
doth—aux. verb to *shun*, indicating pres. tense.
shun—irreg. trans. verb, act., inf., pres., gov. by *doth*.
doth shun—irreg. trans. verb, act., ind. pres., 3rd, sing., agreeing with *who*.
to lie—irreg. intrans. verb, act., inf., pres., gov. by *loves*.
seeking—pres. part. of *to seek*, forming with *is* und. the pres. tense, prog. form, indic., 3rd, sing. of *to seek*, agreeing with its nom. *who*.
what—comp. rel. pro., neut., sing., 3rd, obj., gov. by *with*.
come—irreg. intrans. verb, act., inf. pres., gov. by *let*, und.
hither—adv. of place, qualg. *come*.
but—prep., showing reln. bet. *winter* and *enemy*.
winter—com. noun, neut., sing., obj. gov. by *but*.

2. How many foreign words are there in the above passage? Name them. What are the rest?

All the words in the above passage are English, with the exception of two, viz., *ambition* and *enemy*.

3. What are the different kinds of sentences met with in English called? Name them, and give their various subdivisions.

There are two kinds of sentences, Principal and Subordinate. The union of two or more principal sentences forms a Compound sentence; that of a principal and a subordinate sentence a Complex sentence.

The various kinds of Subordinate sentences are *Noun*, *Adjective*, and *Adverbial*.

Of Adverbial sentences there are those which denote *time*, *place*, *manner*, *cause*, and of Principal sentences there are those which are copulative, disjunctive, adversative, and illative.

4. What language has most largely been infused into the English language? At what periods did this take place?

There is a greater admixture of Latin than of any other language in English. It has become a part of the language, and may be said to have been introduced at four different periods, viz., (1) When the Romans conquered Britain; (2) When Augustine and his fellow-monks taught Christianity to the British; (3) At the time of the Norman Conquest; and (4) Since the latter part of the fifteenth century.

Geography.

(*Answer two questions.*)

1. Draw a map of the Pacific Ocean.

2. What is the influence which the moon has upon the earth? What relationship does it bear to the other planets, and what place does the earth occupy in the planetary system?

Every body attracts every other body according to its size, density, and distance. The moon being at only a moderate distance from the earth attracts the waters of the earth, and as the

moon moves round the earth, and the earth moves on its axis, the attraction of the moon causes an accumulation of water upon the side nearest the moon, and also upon that side farthest from it; these accumulations are called the *tides*. The moon is a satellite of the earth, and moves around it in 29½ days. It goes along with the earth in its orbit. The earth is the third nearest planet to the sun.

3. Gives notes of a lesson on the English Colonies.

I. *Their number and position.*—In every quarter of the globe, but more especially North America, Asia, Australia, and Africa. 'On the British Empire the sun never sets.' Explain and point out.

(*a*) *In Europe.*—Heligoland, 36 miles from Elbe, Malta near Sicily, Gibraltar S. of Spain. Mention former possessions in Europe.
(*b*) *In Asia.*—Cyprus, Aden, Perim, India, Further India, Hong Kong, Labuan, Borneo, and islands.
(*c*) *In Australasia.*—Australia, New Zealand, Van Diemen's Land.
(*d*) *In N. America.*—Dominion of Canada, Newfoundland, and P. Edward's Island.
(*e*) *In C. America.*—West Indies, B. Honduras.
(*f*) *In S. America.*—Guiana.
(*g*) *In Africa.*—Cape Colony, Natal, etc., St. Helena, Ascension, and Settlements on West Coast.

II. *Their Area and Population.*—The total area of the British Colonies is nearly 10 millions of square miles, and the population may be estimated at nearly 300 millions.

The Dominion of Canada, Australia, India, and S. Africa are the largest of the Colonies, and India is the most populous.

Their inhabitants are of all races and of all religions, dispositions, habits, and customs. Mention some.

III. *Value of Colonies.*
(*a*) An outlet for surplus population. Show the necessity for this.
(*b*) Trading stations.
(*c*) Stations for fleets.
(*d*) Markets for our goods.

Give examples of all these.

[*Note.*—The above is sufficient for one lesson.]

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

(*One hour allowed for the Exercise in Needlework.*)

Arithmetic.

MALES.

1. Divide £250 among 100 children, ⅗ of whom are boys, so that what is divided among the boys is to what is divided among the girls as 2 : 3.

No. of boys = ⅗ of 100 = 60.
,, girls = 100 − 60 = 40.
Total amt. received by all boys = ⅗ of £250 = £100.
∴ Each boy will receive $\frac{100}{60}$ = £1 13s. 4d.

Total amt. received by all girls = £250 − £100 = £150.
∴ Each girl will receive $\frac{150}{40}$ = £3 15s. 0d.

2. If *A* has £200 more in the business than *B*, but *B* has his 5 months and *A* only 4 months, and *A* receive £30 more than *B* out of profits worth £210, find the amount of money invested by each?

B's profits = (210 − 30) ÷ 2 = £ 90. ∴ for 1 mo. = £18.
A's ,, = 90 + 30 = £120. ∴ ,, = £30.
Diff. of profit per month = £12.

This is gained by A's extra capital of £200.

∴ £12 : £30 :: £200 : £500. A's capital.
£500 − £200 = £300. B's capital.

3. A person buys tea at 3s. per lb. and some at 2s. per lb., in what proportion must he mix them, so that by selling the tea at 2s. 7½d. per lb. he may gain 20 per cent. on each lb. sold?

The cost price of each lb. of tea would be

120 : 100 : : 2s. 7½d. : 2s. 2½d.

On the two-shilling tea there would thus be a gain of 2½d., but on the three-shilling tea a loss of 9½d. The proportion of 3s. to 2s. would therefore be as

2½ : 9½
or 9 : 39
or 3 : 13. Ans.

4. If 1s. 3d. is the difference between the interest and the discount at 5 per cent. for 3 years, what is the principal?

£115 would produce £17 5s.
And discount on £115 would be £15.
Diff. of int. and dis. on £115 = £2 5s.
∴ £2 5s. : 1s. 3d. : : £115 : £3 3s. 10½d. Ans.

History.

MALES AND FEMALES.

1. When was the Habeas Corpus Act passed? What are its chief provisions?

The Habeas Corpus Act was passed in 1679. It provided—
(*a*) That every prisoner committed for any crime, except treason or felony, is entitled to a writ, by which the gaoler is bound to produce the prisoner in court, and to state the cause of his imprisonment.
(*b*) That every prisoner must be indicted in the first term after his imprisonment, and either brought to trial or discharged in the next term.
(*c*) That when once acquitted by the court no person shall be tried a second time for the same offence.
(*d*) That no inhabitant of Great Britain shall be sent as a prisoner beyond the seas.

This Act is the great safeguard of personal liberty.

2. What was George the First's claim to the throne? Describe any attempt to deprive him of its quiet possession.

George the First was the son of Sophia, Electress of Hanover, and grandson of Elizabeth, the daughter of James I. The crown was settled upon him at the Revolution in 1688. Failing heirs to James II. he was the hereditary claimant to the throne.

The eldest son of James II. was still alive, and had been expressly excluded from the throne in the Second Act of Settlement because of his religion. The Earl of Mar, on his behalf, raised a rebellion in Scotland, but was defeated at Sheriffmuir (1715), and his army dispersed. The Earl of Derwentwater, who led the rebels in England, was compelled to surrender at Preston, and was afterwards executed. This attempt completely failed.

3. Name some of the remarkable men who lived in the eighteenth century.

Among the most remarkable soldiers, sailors, and statesmen were:—The Duke of Wellington, Lord Nelson, Warren Hastings, Captain Cook, Sir Ralph Abercrombie, General Elliott, Admiral Rodney, Earl St. Vincent, William Pitt, Charles James Fox, Edmund Burke, and Brinsley Sheridan.

Among scientists, poets, and writers—so gifted that the age has been called the Augustan age of English literature—were:—Sir Isaac Newton, Benjamin Franklin, Addison, Prior, Defoe, Pope, Swift, Thomson, Fielding, Richardson, Sterne, Smollett, Goldsmith, Dr. Johnson, Gibbon, Burns, Cowper, Adam Smith, Hume, Robertson, and Bishop Butler.

Teaching.

Write notes of a lesson on the 'Barometer.'

I. *Name and Principle.*—Introduce by quoting the lines presaging a wet day:—

'The hollow winds begin to blow,
The clouds look black, the glass is low.'

Weather-glass meant. Other name *barometer*. Give derivation. A column of air, forty-five miles high, is equal in weight to a column of mercury thirty inches, or water thirty-three feet. Any one of these may be substituted for the other. A change affecting one affects the other, provided no pressure is exerted above.

II. *Construction.*—A glass tube 3 ft. long, open at one end, filled with mercury, and inverted in a cup of mercury. Fluid falls till its height equals pressure of atmosphere, leaving a *vacuum* (exp.) in the top. Tube now placed against a scale to indicate height of fluid.

III. *How it Acts.*—When air presses with great force the fluid rises; when it is lighter the fluid falls. The air is heaviest in fine weather, so if the glass rises we know it is likely to be fine, and so on.

IV. *Uses.*—(*a*) As weather-glass.
(*b*) To ascertain heights of mountains.

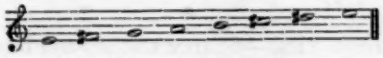
Music.

A quarter of an hour allowed for this paper.

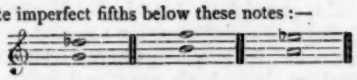
(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

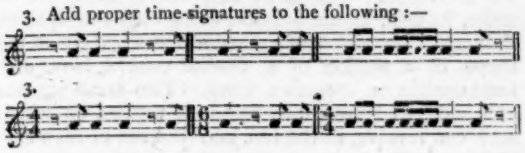
1. What is the difference between the major and minor scales? Write the ascending scale of E minor, using sharp sixth and seventh, and placing the necessary sharps, etc.

1. In the major scale the first third consists of two tones; in the minor, the first third consists of a tone and a semitone; the semitones of the scale are between the second and third, and sixth and seventh, instead of third and fourth, and seventh and eighth.



2. Write imperfect fifths below these notes:—



3. Add proper time-signatures to the following:—

3.

TONIC SOL-FA NOTATION.

1. Write imperfect fifths below the following notes:—(1) *ma*; (2) *la*; (3) *ta*.

1. (1) *lah*$_1$; (2) *ray*; (3) *me*.

2. Write a descending minor scale.

2. l s f m r d t$_1$ l$_1$

3. Re-write the following, halving the value of every note. Use two-pulse measure:—

|d' :— |s :f |m :-.r |d : | : |d :— ‖

3.

|d' :s .f |m „r :d . | :d ‖

—o—

Science Notes.

TOUGHENED GLASS.—A paper read a short time since on this subject at the Society of Arts, by Mr. Frederick Siemens, contained, and elicited in the discussion which followed, some interesting facts. The method of hardening adopted a few years ago by M. de la Bastie was to take the finished article, heat it afresh until the glass became soft, and then immerse it in a bath of heated oil, or other fluid capable of being maintained at a temperature of from 350 to 400 degrees centigrade without evaporation. This mode of procedure is not only a costly addition to the original process of manufacture, but also involves great risk of damaging the surfaces and shapes of the articles operated on; in addition to which, owing to the intense and diverse strains caused by the unequal cooling of the material, the articles are liable to burst suddenly into small fragments either spontaneously or at a slight shock. That the De la Bastie process was however in some instances remarkably efficacious may be gathered from the fact stated by one of the speakers, that it took three shots from a saloon rifle, at twelve paces, to demolish a hardened champagne glass. The new processes, the invention of Mr. Frederick Siemens, the author of the paper, may be briefly described as being three in number: first, by compressing the semi-melted glass between cold metal plates; secondly, by subjecting the articles to a hard-tempering process, enclosed in iron vessels; and, thirdly, by melting the glass in a furnace, and running it into moulds made of a material of the same conductivity as the glass, and allowing it to cool in them. By the first process, glass plates, either flat or bent, can be manufactured of so hard a nature that the diamond will not touch them, and of a strength about eight times that of ordinary glass. Toughened glass of this description is admirably adapted for use in greenhouses, factories, forts, war-vessels, skylights, and, in fact, in all places where the glass is exposed to exceptional risk of breakage.

* * * * *

THE AMMONIAPHONE.—The ammoniaphone is defined as an instrument the employment of which, according to directions, Italianises the voice, and makes a weak voice, or a drawing-room voice, strong, rich, clear, and ringing. The inventor, Dr. Carter Moffat, says that when but a boy he was struck with the rather curious idea that the beauty of Italian vocal music was due to something in the air of Italy, and that the efficacy to invalids of a sojourn in that sunny southern land was due to the same cause. Some ten years ago Dr. Moffat had occasion to visit Italy, and being struck by the apparently bleaching effect produced on vegetation by the air in various localities on the shores of the Adriatic, proceeded to carefully analyse the air and dew in those neighbourhoods. His investigations went to show that the atmosphere there was impregnated with peroxide of hydrogen and free ammonia, the former compound developing with the sunlight, being least in amount at dawn and dusk, and increasing to a maximum about mid-day. The experiments had a practical outcome in the invention of the ammoniaphone, which may briefly be described as a straight metallic tube, containing a material saturated with peroxide of hydrogen and ammonia, and fitted with a mouth-piece midway between the two ends, regulated by suitable valves, for the purpose of inhalation. If report can be believed, the effect of the instrument is decided and satisfactory.

* * * * *

A NEW CHECK-CLOCK.—Many instruments have been devised from time to time for automatically checking the times of arrival of workmen. One which has been lately invented merits notice, if only for the simple mechanism involved. In appearance it may be described as an ordinary clock, with two dials in front, and a slit, like that in a money-box, beneath them. This slit leads into a vertical tube attached to the clock case. The workmen are furnished with circular, metallic, numbered checks, which they have to deliver through this slit as they arrive at the works. It will readily be understood that by detaching the tube, the sequence of the checks it contains will show the order in which the men have arrived. The second of the two dials referred to is connected with a slotted disc, which every now and then, at intervals which may be previously arranged, allows a time-check to pass down into the tube among the workmen's checks. If these time-checks are made to descend, for instance, every five minutes, and the limit of entrance to the works be fixed at half an hour, the examination of the tube at

the end of that time will show the *rouleaux* of workmen's checks divided into six portions by the descent of the six time-checks, each portion containing the checks deposited in that particular five minutes. The time of arrival, therefore, of any particular individual can be easily decided to within a few minutes, by noting the position of his check with respect to the time-checks.

• • • • •

RAILWAY ELECTRIC SIGNALS.—Some special electro magnets have lately been devised by Mr. Stanley Currie for working railway points and signals. The attractive power of an ordinary electro-magnet is practically limited to about half an inch, a distance much too slight to be effectively employed in pulling over points and signals. Mr. Currie has, however, contrived to extend the effective length of pull to three and a half inches, and rendered the magnet so much the more adapted for performing the duties required for railway work. Some idea of the new magnet may be obtained by imagining a soft iron reel, round which silk-covered copper-wire is wound, and into the tube of which slides a soft iron stem or rod, fitted with a disc or cap which comes down over the end of the reel, and prevents the rod from entirely entering the tube. To this disc or cap is fastened the chains or levers required for moving the signal arms or points. When the signalman sends an electric current through the copper wire wound round the reel, that reel is converted into a powerful magnet, which, by the peculiar shape and arrangement of its cap-like armature, not only has its pull lengthened to three and a half inches, as before mentioned, but also is comparatively steady and constant in its effect. Railway semaphores and points arranged on Mr. Currie's principle are already in successful working order in several parts of the kingdom, and there seems some hope that the signalman of the future, instead of having to nearly dislocate his arms in pulling over distant signals, with their heavy paraphernalia of rods and wires, will do all his necessary work by simply starting or stopping the electric current to the Currie long-pull magnet.

• • • • •

A MODEL LENS.—Science teachers and others will be, no doubt, grateful to Mr. J. B. Haycraft, of the Mason College, Birmingham, for a model lens he has lately designed. As may be gathered from the following description, it is both easy and inexpensive to make, its cost, at the outside, being only two or three shillings. It consists of a piece of flat wood cut in the shape of a section of a double convex lens, and fixed upright on a wooden stand. Two small squares of wood are fastened by means of screws, on which they can revolve, at the top and bottom of each side of this wooden lens. A piece of glass tubing, bent to an obtuse angle, is fixed by wire staples to each of these pieces of wood, and finally through each tube is passed a piece of string, by altering the position of which, and rotating the pieces of wood with the glass tubes, the paths of the various rays through the lens can be diagrammatically represented.

Query Column.

RULES.

1. Each correspondent is restricted to *one question.* We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

Arithmetic.

1. ALLYTOM.—How many lbs. of tea at 2s. 8d must a dealer mix with 495 lbs. at 2s. 9d., so that he may realise a profit of 10 per cent. by selling at 3s. a lb.?

Cost price of mixture per lb. $= 3s \times \frac{100}{110}$
$= \frac{10}{11}$ of 3s.
$= 2s.\ 8\frac{8}{11}d.$;

Difference between cost price of mixture and first kind
$= 2s.\ 8\frac{8}{11}d. - 2s.\ 8d.$
$= \frac{8}{11}d.$;

" " " mixture and second kind.
$= 2s.\ 9d. - 2s.\ 8\frac{8}{11}d$
$= \frac{3}{11}d.$;

d. d.
∴ Quantity of 1st kind : Quantity of 2nd kind :: $\frac{8}{11} : \frac{3}{11}$
:: 3 : 8;

∴ Quantity of 1st kind $= 495$ lbs. $\times \frac{3}{8}$
$= \frac{1485}{8}$ lbs.
$= 185\frac{5}{8}$ lbs. Ans.

2. AMY.—Discount on a sum due in one year hence at 5 per cent. per annum is £15. What is the sum?

£ £ £
1 : 19 :: 105 : Sum
3
$= £315.$ Ans.

3. CYMRO BACH.—A person invests in the 3 per cents. so as to receive 3 per cent. clear, when the income tax is 9d. in the £. What percentage will he receive if the income tax be increased to 1s. in the £? (*Longman's* 'Modern Series Arithmetic.')

4
Percentage in 2nd case $= £3 \times \frac{240}{231} \times \frac{19}{20}$
77
$= £3 \times \frac{76}{77}$
$= £\frac{228}{77}$
$= £2\ 19s.\ 2\frac{74}{77}d.$

4. POPOLANI.—A barrel consists of 3 parts ale and 2 parts stout. How much of the mixture must be drawn off and replaced by stout, so that the mixture shall be half and half? (*Brook-Smith.*)

Quantity of ale to be drawn off $= \frac{3}{3+2} - \frac{1}{2}$

$= \frac{3}{5} - \frac{1}{2}$

$= \frac{6-5}{10}$

$= \frac{1}{10}$;

∴ " mixture " " $= \frac{1}{10} + \frac{2}{3}$ of $\frac{1}{10}$

$= \frac{1}{10} + \frac{1}{15}$

$= \frac{3+2}{30}$

$= \frac{5}{30}$

$= \frac{1}{6}$. Ans.

Note.—Yes.

5. SEMPER FIDELIS.—The solidities of two cubes are respectively 5359·375 and 5·359375 cubic feet; find the difference of the lengths of their edges in inches. (*Barnard Smith.*)

5'359'375(17·5
1
$1^2 \times 300 = 300$ | 4359
$1 \times 7 \times 30 = 210$
$7^2 = 49$
559 | 3913
$17^2 \times 300 = 86700$ | 446375
$17 \times 5 \times 30 = 2550$
$5^2 = 25$
89275 | 446375

∴ $\sqrt[3]{5'359375} = 1'75$;

∴ Difference $= 17'5$ ft. $- 1'75$ ft.
$= 210$ in. $- 21$ in.
$= 189$ in. Ans.

6. FOOTBALL.—A man has stock in the 3½ per cents., which brings him in £43 15s. a year. He sells out ½ of the whole at 112½, and invests the proceeds in railway debentures at 128¾. How much per cent. must the dividend of the debentures be, in order that this annual income may be diminished by 10s. 11½d., no brokerage being charged for the sale of the stock, but ¼ per cent. being charged for the purchase of the debentures?

½ of £43 15s. $=$ £8 15s.;

£ £ £
∴ 3½ : 8½ :: 100 : Amount of stock sold out.

$= \frac{2}{7} \times \frac{4}{\cancel{28}} \times \cancel{\pounds 250}$.

£ £ £
112½ : 112½ :: 250 : Amount of debentures.

$= \frac{8}{\cancel{9}\cancel{0}\cancel{3}} \times \frac{\cancel{125}}{7} \times \pounds$

$= \frac{7 \times \cancel{125}}{\cancel{8}} \pounds$

$= \pounds 218\frac{3}{4}$.

Income from debentures $=$ £8 15s. $-$ 10s. 11½d.
$=$ £8 4s. 0¾d.;

£ £ £ s. d.
∴ 218¾ : 100 :: 8 4 0¾ : Dividend of debentures.

$\frac{4}{\cancel{875}} \times \frac{\cancel{100}}{4} \times \frac{4}{\cancel{32}\ 16\ 3}$
35 4

)131 5 0(3 £
105
26
20
525(15s.
525

$= 3\frac{3}{4}$ per cent. Ans.

7. UTILE DULCI.—A and B embark in trade for 5 years; B is to have $\frac{7}{15}$ of the net annual profits for the first half of the time, and half of them for the remainder. After 3½ years, the annual profits, by a lowering of the tariff, were increased in the proportion of 6 to 5, and at the same time became liable to a reduction of 7d. in the pound, by the laying on of the income-tax. At the termination of the partnership, B's share of the total net profits amounted to £987; required the annual profits before the duties were reduced. (*St. John's College Arithmetical Paper.*)

B's share before reduction of duty $= (\frac{7}{15}$ of original annual profits $\times 2\frac{1}{2}) + \frac{1}{2}$ original annual profits

$= \{(\frac{7}{15} \times 2\frac{1}{2}) + \frac{1}{2}\}$ of original annual profits

$= (\frac{7}{6} + \frac{1}{2})$ of original annual profits

$= \frac{5}{3}$ of original annual profits;

" after " " $= \frac{1}{2}$ original annual profits $\times \frac{6}{5} \times \frac{233}{240} \times 1\frac{1}{2}$

$= (\frac{1}{2} \times \frac{6}{5} \times \frac{233}{\cancel{240}} \times \frac{3}{2})$ of original annual profits

$= \frac{233}{400}$ of original annual profits;

∴ $(\frac{5}{3} + \frac{233}{400})$ of original annual profits $=$ £987,

$\frac{1275+699}{800}$ " " $=$ "

$\frac{1974}{800}$ " " $=$ "

∴ Original annual profits $=$ £987 $\times \frac{400}{1974}$

$=$ £400. Ans.

8. SUBSCRIBER.—If 12 horses eat 10 acres of grass in 16 weeks, and 18 horses eat 10 acres in 8 weeks, how many horses would eat 40 acres in 6 weeks, the grass being supposed to grow uniformly?

As the same quantity is eaten in double the time,

∴ The growing grass of 10 acres supplies $\{(12 \times 2) - 18\}$ horses
$= 6$ horses;

ac. ac.
10 : 40
wks. wks. } horses
6 : 16 :: 6 : No. of horses without those supplied by growing grass.

$= (16 \times 4)$ horses

$= 64$ horses;

∴ No. of horses $= 64 + (6 \times 4)$
$= 64 + 24$
$= 88$. Ans.

9. PUPIL TEACHER.—What is the greatest number which, when used as the divisor of 68,130 and 107,275, will leave as remainders 27 and 49 respectively? (*Lower Division*, January, 1883.)

Required G.C.M. of $(68,130 - 27)$ and $(107,275 - 49) = 68,103$ and 107,220;

68103)107226(1
68101
)68103(1
39123
)39123(1
28980
)28980(2
20286
)10143(1
8694
)8694(6
8694

∴ No. $= 1,449$. Ans.

10. A. SMITH.—Divide £2075 into two such parts or sums, that if the first be put out at simple interest for 5 years at 3½ per cent., and the second for 4 years at 3 per cent., the interest on the first sum shall be double that of the second.

1st sum : 2nd sum :: $3 \times 4 \times 2 : 3\frac{1}{2} \times 5$,
:: 24 : 17½,
:: 48 : 35;

£
∴ 48 + 35 : 48 :: 2075 : 1st sum.
875
25
$= 1,200$.

2nd sum $=$ £2,075 $-$ £1,200
$=$ £875.

11. M. R. S.—To complete a certain work B would take twice as long as A and C together, and C three times as long as A and B together, and A, B, and C can, working together, do it in 5 days. In what time could each do it by himself?

A and C can do in 1 day twice as much as B,
∴ A, B, and C " " three times " B;
∴ B can do in 1 day $\frac{1}{4}$ of $\frac{1}{5}$ of the work $=\frac{1}{20}$ of the work;
∴ B can do the work in 15 days.

A and B can do in 1 day three times as much as C,
∴ A, B, and C " " four " " C;
∴ C can do in 1 day $\frac{1}{5}$ of $\frac{1}{4}$ of the work $=\frac{1}{20}$ of the work;
∴ C can do the work in 20 days.

A can do in 1 day $\{\frac{1}{5}-(\frac{1}{15}+\frac{1}{20})\}$ of the work

$$=\left(\frac{1}{5}-\frac{4+3}{60}\right)\text{ " "}$$

$$=\frac{12-7}{60}\text{ " "}$$

$$=\frac{1}{12}\text{ " " ;}$$

∴ A can do the work in 12 days.

12. J. A. S.—How often between 11 and 12 o'clock are the hands of a clock an integral number of minute spaces apart?

The minute-hand moves 12 times as fast as the hour-hand;

∴ The difference between the rates of the minute and hour-hands is 11 times the rate of the hour-hand;

The minute-hand will gain 1 minute in $1\frac{1}{11}$ min.;

∴ At $1\frac{1}{11}$ min. past 11, difference = 6 min.;
" $2\frac{2}{11}$ " " " =7 " ; etc.

∴ There will be an integral number of minute spaces, from difference of 6 min. to difference of 30 min., and then from difference of 29 min. to difference of 1 min.:

∴ No. of times = 25 + 29
= 54. Ans.

Algebra.

1. CLEMENS.—Solve:—

$$\sqrt{5x+1}-\sqrt{3x+7}=\sqrt{2x-6}.$$

(*College of Preceptors.*)

$$\sqrt{5x+1}-\sqrt{3x+7}=\sqrt{2x-6},$$

Squaring each side $\}$ $5x+1-2\sqrt{(5x+1)(3x+7)}-(3x+7)=2x-6$

$$5x+1-3x-7-2\sqrt{15x^2+38x+7}=2x-6$$
$$2x-6-2\sqrt{15x^2+38x+7}=2x-6$$
$$-2\sqrt{15x^2+38x+7}=0$$
$$\sqrt{15x^2+38x+7}=0$$
$$15x^2+38x+7=0$$
$$15x^2-38x=-7$$
$$x^2-\frac{38x}{15}=-\frac{7}{15}$$
$$x^2-\frac{38x}{15}+(\frac{19}{15})^2=\frac{361}{225}-\frac{7}{15}$$
$$=\frac{361-105}{225}$$
$$=\frac{256}{225}$$
$$x-\frac{19}{15}=\pm\frac{16}{15}$$
$$x=\pm\frac{16}{15}+\frac{19}{15}$$
$$\therefore\ x=\frac{7}{3}\text{ or }\frac{1}{5}.$$

2. SOMERSET.—Solve:—

$$\frac{5}{x}+\frac{12}{y}=2;\quad \frac{56}{y}-\frac{20}{x}=5.\quad (\textit{Mansford.})$$

$$(1)\ \frac{5}{x}+\frac{12}{y}=2$$
$$(2)\ \frac{56}{y}-\frac{20}{x}=5$$

(1) ×4 $\}$
$$(1)\ \frac{20}{x}+\frac{48}{y}=8$$
$$(2)\ -\frac{20}{x}+\frac{56}{y}=5$$

Adding $\}$ $\frac{104}{y}=13$

$$\therefore\ y=\frac{104}{13}$$
$$=8.$$

$$(1)\ \frac{5}{x}+\frac{12}{8}=2$$
$$\frac{5}{x}=2-\frac{3}{2}$$
$$=\frac{1}{2}$$
$$\therefore\ x=5\times 2$$
$$=10.$$

3. Q. R. S.—Find that number the double of which increased by 24 exceeds 80 as much as the number itself is below 100. (*Todhunter's* 'Algebra for Beginners.')

Let x = the No.;
Then, $(2x+24)-80=100-x$
$2x+24-80=100-x$
$2x-56=100-x$
$2x+x=100+56$
$3x=156$
$\therefore\ x=52.$

4. MISTY.—Show, without extracting the roots, that

$$\sqrt[3]{20-14\sqrt{2}}+\sqrt[3]{20+14\sqrt{2}}=4.$$

(*Science Examination Papers, 2nd Stage*, 1884.)

Assume, $\sqrt[3]{20+14\sqrt{2}}=x+\sqrt{y}$, (1)

Then, $\sqrt[3]{20-14\sqrt{2}}=x-\sqrt{y}$; (2)

Multiplying $\sqrt[3]{400-392}=x^2-y$
$\sqrt[3]{8}=x^2-y$
$2=x^2-y$
$\therefore\ y=x^2-2.$ (3)

(1) Cubed $\}$ $20+14\sqrt{2}=x^3+3x^2\sqrt{y}+3xy+\sqrt{y^3}$
$\therefore\ 20=x^3+3xy.$

Substituting value of y from (3) $\}$ $x^3+3x(x^2-2)=20$
$x^3+3x^3-6x=20$
$4x^3-6x=20$
$2x^3-3x=10$;

The value of x will be found *by trial* to be 2. Then,
$y=x^2-2=2.$

$$\therefore\ \sqrt{20+14\sqrt{2}}+\sqrt[3]{20-14\sqrt{2}}$$
$$=2+\sqrt{2}+2-\sqrt{2}$$
$$=4.\text{ Ans.}$$

5. MYRIC.—Two trucks whose wheels are of different sizes are in motion; one makes 2002 revolutions more than the other in 7 miles, whereas if its wheels had been twice as large in circumference, it would have made 770 less than the other; find the circumference of the wheels.

Let x and y = No. of revolutions made by the trucks, respectively, in a mile

Then, (1) $x-y=\frac{2002}{7}$
(2) $y-\frac{x}{2}=\frac{770}{7}$
(1) $x-y=286$
(2) $-\frac{x}{2}+y=110$

Adding $\}$ $\frac{x}{2}=396$

$$\therefore\ x=792.$$

(1) $792-y=286$
$\therefore\ y=792-286$
$=506$

∴ Circumf. of wheels of 1st truck $=\frac{7\,280}{792}$ yds.
$=\frac{70}{8}$ yds.
$=2\frac{3}{8}$ yds.;

" " 2nd " $=\frac{7\,280}{506}$ yds.
$=\frac{80}{11}$ yds.
$=3\frac{1}{11}$ yds.

6. BLACKBOARD.—The sum of three terms in Geometrical Progression is 63, and the difference of the first and third terms is 45; find the terms. (*Todhunter's* 'Algebra for Beginners.')

$$\left.\begin{array}{l}(1)\ a+ar+ar^2=63\\(2)\ ar^2-a\ \ \ =45\end{array}\right\}$$
$$\left.\begin{array}{l}(1)\ a(r^2+r+1)=63\\(2)\ a(r^2-1)\ \ \ =45\end{array}\right\}$$
$$\therefore\ \frac{r^2+r+1}{r^2-1}=\frac{63}{45}$$
$$=\frac{7}{5}$$
$$5r^2+5r+5=7r^2-7$$
$$7r^2-5r^2-5r=5+7$$
$$2r^2-5r=12$$
$$r^2-\frac{5r}{2}=6$$
$$r^2-\frac{5r}{2}+(\tfrac{5}{4})^2=6+\tfrac{25}{16}$$
$$=\tfrac{121}{16}$$
$$r-\tfrac{5}{4}=\pm\tfrac{11}{4}$$
$$r=\pm\tfrac{11}{4}+\tfrac{5}{4}$$
$$\therefore\ r=4,\text{ or }-\tfrac{3}{2}.$$
$$(2)\ a(r^2-1)=45$$
$$a\{4^2,\text{ or }(-\tfrac{3}{2})^2-1\}=45$$
$$a(16,\text{ or }\tfrac{9}{4}-1)=45$$
$$15a,\text{ or }\frac{5a}{4}=45$$
$$\therefore\ \underline{a=3,\text{ or }36.}$$
$$\therefore\ \text{Series}=3,\ 12,\ 48;$$
$$\text{Or, }\underline{36,\ -54,\ 81.}$$

7. Discipulus.—Simplify :—

$$\frac{\left(\sqrt{\frac{x}{y}}-\sqrt{\frac{y}{x}}\right)\left(\sqrt{\frac{y}{z}}-\sqrt{\frac{z}{y}}\right)\left(\sqrt{\frac{z}{x}}-\sqrt{\frac{x}{z}}\right)}{\left(\frac{1}{xz}-\frac{1}{yz}\right)\left(\frac{1}{yx}-\frac{1}{zx}\right)\left(\frac{1}{zy}-\frac{1}{xy}\right)}.$$

(*College of Preceptors*, Midsummer, 1884.)

$$\frac{\left(\sqrt{\frac{x}{y}}-\sqrt{\frac{y}{x}}\right)\left(\sqrt{\frac{y}{z}}-\sqrt{\frac{z}{y}}\right)\left(\sqrt{\frac{z}{x}}-\sqrt{\frac{x}{z}}\right)}{\left(\frac{1}{xz}-\frac{1}{yz}\right)\left(\frac{1}{yx}-\frac{1}{zx}\right)\left(\frac{1}{zy}-\frac{1}{xy}\right)}$$
$$=\frac{\sqrt{xy}\left(\frac{1}{y}-\frac{1}{x}\right)\cdot\sqrt{yz}\left(\frac{1}{z}-\frac{1}{y}\right)\cdot\sqrt{xz}\left(\frac{1}{x}-\frac{1}{z}\right)}{\frac{1}{z}\left(\frac{1}{x}-\frac{1}{y}\right)\cdot\frac{1}{x}\left(\frac{1}{y}-\frac{1}{z}\right)\cdot\frac{1}{y}\left(\frac{1}{z}-\frac{1}{x}\right)}$$
$$=\frac{\sqrt{x^2y^2z^2}\left(\frac{1}{y}-\frac{1}{x}\right)\left(\frac{1}{z}-\frac{1}{y}\right)\left(\frac{1}{x}-\frac{1}{z}\right)}{\frac{1}{xyz}\left(\frac{1}{x}-\frac{1}{y}\right)\left(\frac{1}{y}-\frac{1}{z}\right)\left(\frac{1}{z}-\frac{1}{x}\right)}$$
$$=\frac{-xyz\left(\frac{1}{x}-\frac{1}{y}\right)\left(\frac{1}{y}-\frac{1}{z}\right)\left(\frac{1}{z}-\frac{1}{x}\right)}{\frac{1}{xyz}\left(\frac{1}{x}-\frac{1}{y}\right)\left(\frac{1}{y}-\frac{1}{z}\right)\left(\frac{1}{z}-\frac{1}{x}\right)}$$
$$=\frac{-xyz}{\frac{1}{xyz}}$$
$$=\underline{-x^2y^2z^2.}\quad\text{Ans.}$$

8. Platypus.—(*a*) If $(1+x)^n=1+p_1x+p_2x^2+\ldots+p^nx^n$;
Show that $p_1+\frac{2p_2}{p_1}+\frac{3p_3}{p_2}+\ldots+r\frac{p^r}{p_{r-1}}+\ldots$
$=\frac{n}{2}(n+1).$

(*b*) Write down the middle term of
$(x+\frac{1}{2})^{2n}$. (*Certificate*, 1884.)

(*a*) $p_1=n$;
$$\frac{p_2}{p_1}=\frac{2n(n-1)}{1.2.n}=(n-1);$$
$$\frac{3p_3}{p_2}=\frac{3n(n-1)(n-2)}{1.2.3.\frac{n(n-1)}{1.2}}=(n-2);$$

We therefore require the sum of an Arithmetical series, where he first term $=n$, difference $=-1$, and number of terms $=n$.

$$\text{Sum}=\{2a+(n-1)d\}\times\frac{n}{2}$$
$$=[2n+\{(n-1)\times-1\}]\times\frac{n}{2}$$
$$=(2n-n+1)\times\frac{n}{2}$$
$$=\underline{\frac{n}{2}(n+1).}$$

(*b*) Middle term of $(x+\frac{1}{2})^{2n}$
$$=\frac{\lfloor 2n}{\lfloor n\ \lfloor n}x^n(\tfrac{1}{2})^n;$$
$$\because\ \lfloor 2n=1.3.5\ldots(2n-1)2.4.6\ldots2n$$
$$=1.3.5\ldots(2n-1)2^n\ \lfloor n$$
$$=\frac{1.3.5\ldots(2n-1)}{\lfloor n}2^n\ x^n\ \frac{1}{2}$$
$$=\underline{\frac{1.3.5\ldots(2n-1)}{\lfloor n}x^n.}$$

Note.—The proof of first part of query is given in almost every work on algebra.

Mensuration.

1. Antioch.—Find the weight of a 13-inch iron shell, the thickness of which is 2 inches, the weight of a cubic foot of iron being 441 lbs. ($\pi=\frac{22}{7}$). (*Civil Service Exam.*, Nov., 1883.)

Solidity of a sphere $=\frac{4}{3}\pi r^3$, where $r=$radius;
$$\therefore\ \text{Solidity of shell}=\left[\tfrac{4}{3}\times\tfrac{22}{7}\{(\tfrac{13}{2})^3-(\tfrac{9}{2})^3\}\right]\text{cub. in.}$$
$$=\left\{\frac{88}{21}\left(\frac{2197-729}{8}\right)\right\}\text{cub. in.}$$
$$=\left(\frac{88}{21}\times\frac{1468}{8}\right)\text{cub. in.}$$
$$=\tfrac{1617}{21}\text{cub. in.};$$
$$\therefore\ \text{Weight of shell}=\left(\frac{4037}{\cancel{161}\cancel{48}}\times\frac{\overset{7}{\cancel{441}}}{\cancel{1728}}\right)\text{lbs.}$$
$$=\tfrac{2121}{144}\text{ lbs.}$$
$$=196\tfrac{57}{144}\text{ lbs.}$$
$$=\underline{1\text{ cwt. }3\text{ qrs. }3\tfrac{57}{144}\text{ oz.}}\quad\text{Ans.}$$

2. Subscriber.—A hexagonal prism is 16 inches in length, and each side of the base measures 3 inches. Compute its solidity. (*Elliott.*)

In a regular polygon of n sides, if $2a$ be the length of one of the sides,
$$\text{Area}=na^2\cot\frac{180^\circ}{n};$$
$$\therefore\ \text{Solidity of hexagonal prism}$$
$$=\left\{6\times(\tfrac{3}{2})^2\times\cot\frac{180^\circ}{6}\times16\right\}\text{ cub. in.}$$
$$=(96\times\tfrac{3}{4}\times\cot30^\circ)\text{ cub. in.}$$
$$=(216\times\sqrt{3})\text{ cub. in.}$$
$$=\sqrt{3\times216^2}\text{ cub. in.}$$
$$=\sqrt{139968}\text{ cub. in.}$$
$$=\underline{374\cdot12\ldots\text{cub. in.}}\quad\text{Ans.}$$

3. S. L.—What must be the dimensions of a rectangular cistern, of which the base is a square, and the depth equal to a quarter of a side of the base, in order that it may contain 1,932 gallons of water, a gallon occupying 278 cubic inches?

$$\text{Side}^2\times\frac{\text{Side}}{4}=(1932\times278)\text{ cub. in.}$$
$$\text{Side}^3=\frac{\overset{161}{\cancel{1932}}\times\overset{139}{\cancel{278}}\times4}{\cancel{1728}}\text{ cub. ft.}$$
$$=\tfrac{23191}{18}\text{ cub. ft.}$$
$$=1243\cdot27\text{ cub. ft.},$$
$$\therefore\ \text{Side}=\sqrt[3]{1243\cdot27}\text{ ft.}$$
$$=10\cdot75\ldots\text{ft.};$$
$$\text{Depth}=\underline{2\cdot68\ldots\text{ft.}}$$

4. ESSAYIST.—The weight of a hollow cylinder = $\frac{3}{17}$ of the weight of a solid cylinder, which will just fit inside; find the ratio of the internal and external diameters of the cylinder.

Volume of hollow cylinder = {(external diameter)^2 − (Internal diameter)^2} × length;
,, ,, solid cylinder = (Internal Diameter)^2 × length;
∴ {(External Diameter)^2 − (Internal Diameter)^2} × length
= $\frac{3}{17}$ (Internal Diameter)^2 × length,
(External Diameter)^2 − (Internal Diameter)^2
= $\frac{3}{17}$ (Internal Diameter)^2,
(External Diameter)^2 = $\frac{3}{17}$ (Internal Diameter)^2 + (Internal Diameter)^2
= $\frac{20}{17}$ (Internal Diameter)^2,
External Diameter = $\frac{2}{3}$ Internal Diameter;
∴ Internal Diameter : External Diameter :: 4 : 5.

5. TREORCHY BOY.—Two trees stand on opposite sides of a stream 40 ft. wide, the height of one tree is to the width of the stream as 8 to 4, and the width of the stream is to the height of the other tree as 4 to 5; what is the distance between their tops? (*Ricks.*)

Height of one tree = $\frac{4}{5}$ of 40 ft.
= 20 ft.;
Height of other tree = $\frac{4}{5}$ of 40 ft.
= 50 ft.;
∴ Distance between their tops = $\sqrt{(50-20)^2+40^2}$ ft.
= $\sqrt{900+1600}$ ft.
= $\sqrt{2500}$ ft.
= 50 ft. Ans.

6. BLACKBIRD.—A block of timber has circular ends, of which the diameters are 12 and 8 ft., and is 30ft. long; find the ratio of the true volume to that obtained by the 'measurer's rule,' viz., multiply the square of the mean quarter girt by the length. (*Certificate*, 1884.)

If a^2 and b^2 = areas of the two ends,
True volume = $(a^2+ab+b^2)\times\frac{1}{3}$ length
= [{(12^2 × ·7854) + (12 × 8 × ·7854) + (8^2 × ·7854)} × $\frac{1}{3}$ of 30] cub. ft.
= {(144 + 96 + 64) × ·7854 × 10} cub. ft.
= (304 × 7·854) cub. ft.;
Volume by 'measurer's rule'
= $\left\{\left(\frac{1}{4}\text{ of }\frac{12+8}{2}\times 3\cdot1416\right)^2\times 30\right\}$ cub. ft.
= {(7·854)^2 × 30} cub. ft.;
∴ Ratio = (304 × ·7854) : (7·854)^2 × 30
= 304 : 7·854 × 30
= 76 : 3·927 × 15
= 76 : 58·905
= 76,000 : 58,905
= 15,200 : 11,781.

7. STUDENT.—The diameter of a sphere being 2 ft., segments whose heights are 8 and 6 in. respectively are cut off from the top and bottom by parallel sections; find the volume of the remaining solid zone.

Rule for finding the solidity of the zone of a sphere:—
From the square of the diameter of the sphere deduct one-third of the square of the height of the middle zone; multiply the remainder by the height, and then by ·7854; the last result will be the solidity.

Height of zone = 2 ft. − (8 in. + 6 in.) = 10 in.;
∴ Volume of zone = $\{(24^2-\frac{10^2}{3})\times 10\times\cdot7854\}$ cub. in.
= {(576 − 33$\frac{1}{3}$) × 7·854} cub. in.
= (542$\frac{2}{3}$ × 7·854) cub. in.
= (1628 × 2·618) cub. in.
= 4262·104 cub. in.
= 2 cub. ft. 806·104 in. Ans.

General.

1. PUER.—You will find the solution of your query in our issue for May, 1882.

2. RUM'NS FROM ROME.—The solution of your query appeared in our issue for May, 1883.

3. G. N.—The second method of solution is the better way.

4. WELLINGTON.—A series of papers on 'School Drill' will appear in the current volume of the PRACTICAL TEACHER.

5. GENTIL.—

Sentence.	Kind of Sentence.	Connective.	Subject.	Predicate.	Object.	Extensn. of Pred.
(*a*) As one [stands]	Adv. sent. (manner) to *f*.	As	one	[stands]		
(*b*) That through the door hearing the holy organ rolling waves of sound on roof and floor, and anthem sung is charmed	Adj. sent. to *one* in *a*	*In rel. pro.*	That hearing through the door the holy organ rolling waves of sound on roof and floor, and anthem sung	is charmed		
(*c*) And [that is] tied to where [where = the place on which]	Adj. sent. to *one* in *a*	And	[that]	[is] tied	to where (ind. obj.)	
(*d*) he stands [on which]	Adj. sent. to *where* in *a*.	*In rel. pro.* und.	he	stands	[on which]	
(*e*) where broad sunshine laves the lawn by some cathedral	Adv. sent. (place) to *is charmed* in *b*.	where	broad sunshine	laves	the lawn by some cathedral	
(*f*) So stood I	Princ. sent.		I	stood		so (manner)
(*g*) When that flow of music left the lips of her	Adv. sent. (*time*) to *f*	when	that flow of music	left	the lips of her	
(*h*) that died to save her father's vow	Adj. sent. to *her* in *g*.	*In rel. pro.*	that	died		to save her father's vow (reason)

6. ULTIMA THULE.—F.R.G.S. and F.S.A. are titles conferred by the Geographical Society and the Society of Arts, respectively, upon nomination by Fellows already admitted, and by payment of an entrance fee and yearly subscription. Applicants are expected to be interested in the objects of the society, and may be rejected by an unfavourable ballot.

7. A SCOTCH SUBSCRIBER.—The answers printed in this journal were those given in the examination, so far as the candidates could reproduce them. Small hand, 85 per cent.; large, 70 per cent.

8. GEO. HENRY.—(γ) *Morell's* or *Mason's* 'Grammar,' *Mackay's* 'Elements of Geography,' and *Hewitt's* 'Colonies,' *Collins'* 'Students' Atlas,' *Smith's* 'Smaller History,' *Mansford's* 'Arithmetic,' *Todhunter's* 'Euclid and Algebra for Beginners,' *Morell's* 'Spelling Manual,' *McLeod's Mulhäuser's* 'Copy Books', *Yule's* 'Drawing Series.'

9. POLUS.—Your penmanship is excellent; consult the numbers of this journal for 1884; the Matriculation Hints there given by H. A. Reatchlous, M.A., B.Sc. (Lond.), afford the latest and most reliable information.

10. OLYMPIC.—Large hand, 80 per cent. Small hand is too heavy and not sufficiently round. Copy from a good model twice a week; 70 per cent.

11. EDUCO.—Write to the Registrar, London University, Burlington Gardens, W., for matriculation regulations. See 'Polus.'

12. EDGAR A. ROSS.—No recitations are heard during the July examination. Small hand, 85 per cent. Large hand, the lower curves are too thick in stroke and too round. Imitate a good copy. Sixty-five per cent.

13. CONSTANT SUBSCRIBER.—By recent regulations, a certificated teacher may apply to the Department to have his name

placed upon the list of candidates for the post of 'Assistant Inspector.' Send for full particulars to the Education Department, Whitehall, S.W.

14. Gwylym Pywell.—(1) Eighty-five per cent. (2) The large hand writing reduces the mark. You do not practise large hand writing, it looks simply like small hand enlarged. The curves are pointed, the letters need opening out. Imitate a good copy. (3) Very good.

15. Northumbrian.—We thank you for the hint. Your small hand is worth 85 and large hand 80 out of 100 marks.

16. E. J. G.—(1) The advanced stage will bring in most marks. (2) Seventy per cent. for small hand. Sixty-five large hand.

17. W. W.—As a teacher of handwriting, you must learn to slope your letters and acquire a regular slope throughout each copy. Small hand, 65 per cent. Large hand, 65 per cent.

18. Obscurity.—Small hand, 70 per cent. Large hand, 65 per cent.

19. Zero.—*Todhunter's* works, published by Macmillan, for mathematics, etc. *Deschanel* for 'sound, light, and heat,' and 'magnetism and electricity,' last editions.

20. Fred Coates asks the numerous readers of this journal to kindly give him the author of the following lines—

> 'The day is cold, and dark, and dreary;
> It rains, etc., etc.'

A child has already suggested *Morell's* 'Grammar,' an answer we cannot accept.

21. Subscriber.—(1) In oldest English there were several plural suffixes: *-as, -an, -a, -u*; as stan-*as*=stones, steor*ran*=stars. In the thirteenth century these were reduced to *-es* and *-en*, the *a* having been changed to *e*. In the fourteenth century words of French origin were the first to eliminate the *e*, thus leaving the suffix simply *s*. This soon became general.

(2) Every inflected language tends to throw off superfluous inflections, and then even necessary inflexions, their places being supplied, in the case of nouns, by prepositions, and in the case of verbs by auxiliaries; *e.g.*, instead of '*mannum*,' dat. plural, we use '*for* men.'

In the case of the verb, the inflected form (which is nearly identical with the indicative) is retained in the antecedent clause; while the loss of inflection is supplied in the consequent clause by auxiliaries, *e.g.*, If thou *came*, he *would be* happy. *Came* is the inflected form, *would be* the auxiliary and modern form.

22. J. Bonson.—We cannot direct you to books better suited to your requirements.

23. B. T. J.—Apply Education Department, Whitehall, S.W., and the necessary forms will be sent. The last school, certainly, and be prepared with one from a previous school.

24. Reform.—(1) Thanks for your suggestion. (2) The 'Complete School Management,' published by the National Society. (3) Yes; sent carriage paid upon receipt of P.O.O. for 7s. 6d.

25. M. H.—Your writing, in both styles, is too upright. Adopt a slightly sloping form of letter, and in your large hand, especially, make the down strokes thicker than the up strokes. Sixty-five per cent. With a little practice and good models, your writing would rapidly improve.

26. Tutus dum Rectus.—*There* in the sentence you give is not an adverb of place, as it usually is. The word is etymologically connected with *that*, and some grammarians speak of it as a pronominal word occupying the place of the subject. It has a predicative character, and may be parsed as an expletive adverb introducing the sentence and modifying *are*; or as a predicative adverb. In analysis it is not an extension, but must be placed along with the predicate, unless you prefer the opinion that it has a pronominal use and place it as the subject. We think the former is preferable.

27. Subscriber.—

Being—pres. part. of the intrans. verb '*to be*,' aux. to *caught*, and indicating pass. voice, referring to *caught fox*.
caught—past part. of trans. verb *to catch*, ref. to *fox*.
being caught—pres. part., pass. voice of trans. verb *to catch*, ref. to *fox*.
by—prep., showing rel. bet. *save* and *leaving*.
leaving—pres. part. of *to leave*, used as verbal or abs. noun, neut., sing., 3rd, obj., gov. by *by*.
upon—prep., showing rel. bet. *began* and *going*.
going—pres. part. of *to go*, used as verbal or abs. noun, neut., sing., 3rd, obj., gov. by *upon*.
abroad—adv. of place, modifying *going*.
began—irreg. trans. verb, act., ind. past, 3rd, sing., agreeing with its nom. *he*.
to—a particle, sign of inf. mood.
be—irreg. intrans. verb, act., inf. pres., gov. by *began*.
so—adv. of degree, mod. *ashamed*.
ashamed—adj. of quality, qual. *he*.
that—cop. conj., joining the sent. *he began to be ashamed* and *he wished*.

ANALYSIS.

Sentence.	Kind of Sent.	Connective.	Subject.	Predicate.	Object.	Extension.
(*a*) A fox, being caught in a trap, was glad to save his neck by leaving his tail behind him	Prin. S.		A fox being caught in a trap	was glad [to save his neck by leaving his tail behind him] [to, etc., might be called I. O.]		
(*b*) But upon going abroad into the world he began to be so ashamed of his defect	Prin. S. disj. co-ord. with (*a*)	but	he	began	to be so ashamed of his defect	upon going abroad into the country (time)
(*c*) that he almost wished	Adv. S. of manner to (*b*)	that	he	wished		almost (number)
(*d*) he had died in the trap	Noun S. obj. to (*c*)	*that* und.	he	had died		in the trap (place)

28. Dito.—You will find the solution of your query in our issue for March, 1884.

29. Magna Charta.—You must not paint the tops of your long down strokes. Small hand writing is too small, and very irregular in size. Small hand, 65%; large hand, 70%.

30. 'Dio.'—Each correspondent is restricted to *one* question. See Rule I., Query Column. (*a*) Enter on the form you fill up: 'Sat for ——— Drawing, May, 1885.' (*b*) No. (*c*) Large, 70%; small, 80%.

31. Gratia.—You will find a full answer to your query in last month's Practical Teacher.

32. A. W. M.—(1) Yes; but wanting in style. (2) No. (3) *Taylor's* 'Notes,' published by National Society; and *Dr. Morris'* 'Elementary Lessons in Historical Grammar.'

33. Skylark.—The down strokes in both large and small hand are heavy and very lumpy. Value about 50%.

34. Subscriber.—A '*continental basin*' is a drainage area the rivers of which do not enter the ocean—*e.g.*, the area around the Caspian Sea drained by the Volga, Oural, etc., is a continental basin partly in Europe and partly in Asia.

35. A Safe One.—(*a*) *Prof. Morley's* 'First Sketch of English Literature' contains an account of the literature of this period. We recommend it. (*b*) What the Notes of the Clarendon Press fail to supply, the Anglo-Saxon in *Earle's* 'Anglo-Saxon Primer' will give.

36. Junius.—*Latin. Merryweather*, Books IV. to VI., 'Gallic War.' Rivington and Co. (if out),
Greek. Hellenica I. and II., by *Hailstone*. Macmillan.
Sight Translation. Smith's 'Principia Latina,' Part II. Murray.

37. 'DIO.'—

$2\frac{1}{2}$d. = buying price per qt.
4d. = selling ,, per qt. to gain 60%.
3d. = selling ,, of mixture.

In order to sell milk worth 4d. at 3d. per qt., he must mix water so that 4 qts. of the mixture sell for 3 qts. of the pure milk. Hence the mixture will be

$\frac{3}{4}$ milk $\frac{1}{4}$ water.
3 : 1 = ratio between milk and water.

$\therefore \frac{1}{3}$ qt. = amount of water to be added to each quart of milk.

38. EINE VERLEGENHEIT.—A revenue cutter observes a smuggler q leagues directly to windward, and gives chase, sailing at $5\frac{1}{2}$ points from the wind, and making tacks of $4p$ miles. The smuggler lies off on the other tack at $2\frac{3}{4}$ points, making tacks of $\frac{1}{2}p\sqrt{3}$ miles, its rate of sailing being to the cutter's as $1 : 4\sqrt{3}$. They sail half the above distance before the first tack. In what tack will the smuggler be in range of the cutter's guns, which carry r miles? Illustrate by a diagram.

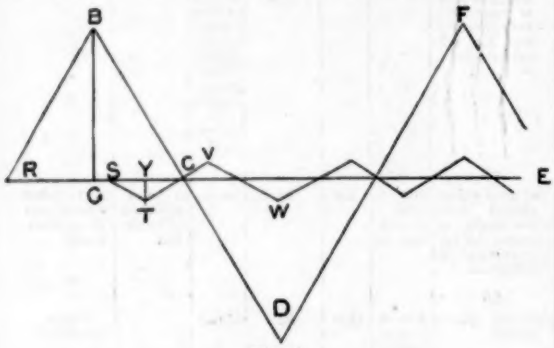


Fig. A.

Fig. A will show the courses of the two boats, viz., RBCD... that of the cutter, and STV... that of the smuggler. The wind is blowing in the direction of ER.

Since $(5\frac{1}{2} \div 8)$ of $90° = 60°$ $\therefore$ RBC is an equilateral triangle, and RG : RB = 1 : 2.

But RB (the half-tack) $= 2p$ $\therefore$ RG $= p$.

Again, since $(2\frac{3}{4} \div 8)$ of $90° = 30°$,

$\therefore$ STY is half an equilateral triangle, and ST : SY = 2 : $\sqrt{3}$;

But ST (the half-tack) $= \frac{1}{2}p\sqrt{3}$;

$\therefore$ SY is $= \frac{1}{2}p$.

Note.—We do not use this fact at all; nor, indeed, is it necessary to know the length of the tack gone over by the smuggler to solve the problem.

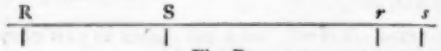


Fig. B.

In Fig. B, let R, S, be the original positions of the cutter and smuggler on RE, and r, s, the last points in RE that they passed over before they came within gunshot of each other. Then RS $= 3q$ miles, and $rs = r$ miles.

Let x = number of half-tacks the cutter takes before coming within gunshot of smuggler.

From Fig. A, since RG $= p$,

$\therefore$ R$r = xp$. But the cutter passes over twice this distance, since RB = 2RG, and takes $\frac{2xp}{4\sqrt{3}}$ units of time to do it: the unit of time being the time the cutter takes to pass over $4\sqrt{3}$ miles and the smuggler 1 mile.

Again, S$s = xp + r - 3q$, and this distance : distance passed over by smuggler as $\sqrt{3} : 2$; $\therefore$ distance passed over by smuggler $= \frac{2}{\sqrt{3}}(xp + r - 3q)$, and he takes $\frac{2}{\sqrt{3}}(xp + r - 3q) \div$ units of time.

But the times are equal;

$$\therefore \frac{2xp}{4\sqrt{3}} = \frac{2}{\sqrt{3}}(xp + r - 3q)$$
$$xp = 4xp + 4r - 12q$$
$$\therefore 3xp = 12q - 4r$$
$$x = \frac{4q}{p} - \frac{4r}{3p}$$

$\therefore$ the number of tacks will be half this, viz.:—

$$\frac{2q}{p} - \frac{4r}{3p}$$

Or the tack of the cutter in which they come within gunshot is either the above or the next greater integer.

39. G. O. M.—The following are suited for matriculation:—(1) *Dr. Wormell's* 'Nat. Phil.' (2) *Macmillan's* 1st and 2nd years' 'French Course.' (3) *Roscoe's* 'Chemistry.'

40. ANXIOUS ASSISTANT.—(1) *Dr. Newsholme's* 'Hygiene. (2) *Tanner's* (Macmillan), with a fuller knowledge of Chemistry and Geology. For the first of these, *Roscoe's* 'Chemistry,' and for Geology, *Ramsey's* 'Geology and Physical Geography of the British Isles.' *Stanford* will suit you, especially the chapter on soils.

41. J. W.—(1) The solution of your query appeared in our issue for June, 1882. (2) 'Sarcophagus' gave 190 qrs. for the answer, but another correspondent pointed out that it ought to be 90 qrs., as the agent plundered both in receiving and delivering.

42. TRIANGLE.—Your query was solved in our issue for February, 1884.

43. G. HAMPSHIRE.—You will find the solution of your query in our issue for February, 1883.

44. OMICRON.—Ei adstabam cum diceret se te dicentem audivisse me rediisse.

45. J. H. SLADDIN.—The volume can be got by the following statement, or by using the formula $\frac{PV}{T} = \frac{P'V'}{T'}$ where T stands for absolute temperature.

$$283 : 289{\cdot}4 :: 150 : x$$
$$520 : 500$$
Or $$\frac{500 \times 150}{283} = \frac{520 \times V'}{289{\cdot}4}$$
In either case the Ans. $$= \frac{500 \times 150}{283} \times \frac{289{\cdot}4}{520}$$
$$= 147{\cdot}49.$$

The answer sent is wrong. If it were correct, $\frac{500 \times 150}{283}$ would be $= \frac{142{\cdot}029 \times 520}{289{\cdot}4}$ by the above formula.

46. TREWERRY.—The pressure on the inner surface of a cylinder, fitted with a piston, full of elastic fluid, is 20 lbs. to the square inch; when the piston is pushed in 2 inches, the pressure becomes 30 lbs. to the square inch. Find the length of the cylinder.

Since the pressure varies inversely as the space occupied by the elastic fluid, and the space occupied varies directly as the length of the cylinder, we have, if x inches is the length of the cylinder,

$$x : x - 2 = \tfrac{1}{20} : \tfrac{1}{30}$$
Or $20x = 30x - 60$
Or $x = 6$. Ans. 6 inches.

47. H.T.—Three men play with 3 dice for a sovereign. They have one throw each, but in the case of ties to throw again. A throws first, and obtains 13. What is a fair price for his chance?

The possible throws are 3, 4...to 18, and of these 3 and 18 can be thrown only in one way each, 4 and 17 in 3 ways each, 5 and 16 in 6 ways each, 6 and 15 in 10 ways each (viz., 9 other ways and 2, 2, 2, or 5, 5, 5), 7 and 14 in 15 ways each, 8 and 13 in 21 ways each 9 and 12 in 25 ways each, and 10 and 11 in 27 ways each, or 216 (*i.e.* 6^3) in all; *e.g.* to throw 14, we may either throw 1, 1, 5 (in 3 ways), 1, 2, 4 (in 6 ways) 1, 3, 3 (in 3 ways), or 2, 2, 3 (in 3 ways), *i.e.*, 15 ways. Hence B's chance to *beat* A is $\frac{91}{216}$ and is worth $\pounds\frac{91}{216}$; his chance to *equal* A is $\frac{21}{216}$, and is worth $\frac{21}{216}$ of 10s. (since having equalled A his chance in throwing off the tie is worth 10s.), and his chance of equalling A and B is $\frac{21 \times 21}{216 \times 216}$, and is worth $\frac{21 \times 21}{216 \times 216}$ of 6s. 8d. Since supposing they all throw 13, their chances are worth 6s. 8d. each. Hence B's chance is worth altogether

$$\pounds\left(\frac{91}{216} + \frac{21}{216 \times 2} + \frac{21 \times 21}{216 \times 216 \times 3}\right) \text{ or } \pounds\frac{2233}{10368}.$$

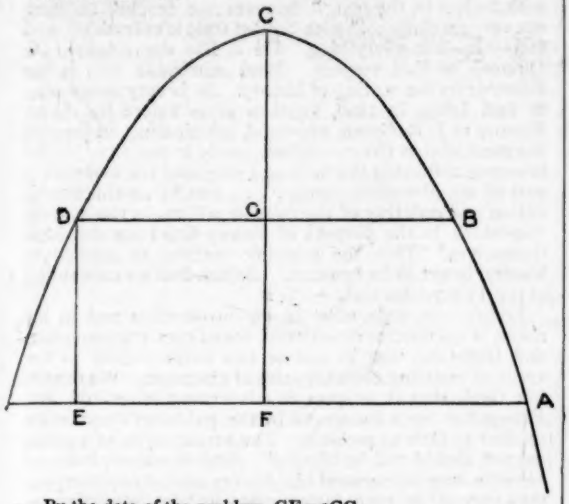
But B's chance is worth the same.

$\therefore$ A's chance is worth $\pounds\frac{15552 - 6650}{15552}$ or $\pounds\frac{4451}{7776}$,

or 11s. $5\frac{63}{97}$d. Ans.

48. Herne Hill.—A stone is thrown at a bird sitting at the top of a tree. After passing through the spot where the bird is sitting, it rises to a height double that of the tree. At the moment of the stone leaving the thrower's hand, the bird flies horizontally, and is struck by the stone in its descent. Compare the horizontal velocities of the bird and the stone.

The curve in the figure will show the path of the stone. A is the point of projection; B the original position of the bird; C the highest point the stone reaches; and D the point where the stone hits the bird.



By the data of the problem, CF=2CG.
By the properties of the curve (a parabola)

$$BG^2 : AF^2 = 1 : 2 \text{ or } AF = \sqrt{2}.BG$$

But BD (2BG) and AE (AF+BG) represent the respective *horizontal* velocities of the bird and stone. Hence

Hor. vel. of bird : hor. vel. of stone = BD : AE
= 2BG : AF+BG
= 2BG : $\sqrt{2}$BG+BG
= 2 : $\sqrt{2}$+1.

49. R. B.—The question is evidently incorrect. The slower snail crawls (70 ft. ÷ 14) or 5 ft. per hour, and therefore the other crawls (5 ft. + 40 ft.), or 45 ft. per hour. In 14 hours the faster snail would crawl (45 ft. × 14), or 630 ft., and yet the query states that it travels only (70 + 10) ft., or 80 ft. in that time.

50. Assistant.—The price of the best quality is 43$\frac{1}{11}$s. As you may have copied the query incorrectly, would you kindly examine it?

Publications Reviewed.

Kalif Stork and the Phantom Crew. Extracted from 'Selections from Hauff's Stories.' A First German Book for Students. Edited by W. E. Mullins, M.A., and Francis Storr, M.A. Rivingtons.

Dr. Lange has shown us, in his edition of 'Meister Martin,' what the editing of a 'German Reader' for English students can and should be. Perhaps his excellent work has made us somewhat over-critical. Certain it is that after his volume this one strikes us as very disappointing. The selection of Hauff's bright and amusing tales—which are also admirable specimens of pure and idiomatic German—is a very good one. We are sure all young readers—and for these we presume that this 'First German Book' is intended—will be delighted with them. But with the selection of the stories our praise must end. There is no account whatever of Hauff—yet, surely, young readers should at least be told to what period the works they are studying belong, or something of the man who wrote them; and there are no notes. There is certainly a very full vocabulary, with some etymological information that might prove useful to advanced pupils, but which, without elucidating notes, will be worthless to young beginners. All the words given by Mr. Mullins and Mr. Storr could be found equally well in a dictionary; and, unless further explanation is given, there is no need to include them in a 'Reader' at all. We will give but one example, taken quite at random, of the difficulties a student is likely to meet with in this volume. On p. 110 the word 'wohl' is translated—and quite correctly translated—'well.' Immediately below it the phrase 'es war ihm wohl' is translated—and more or less correctly translated—'he was happy.' Here the confused pupil finds that 'wohl' means both 'well' and 'happy'; and probably he has already found that it means 'perhaps,' and that when added to 'doch' it further develops or intensifies the significance of the sentence in which it occurs. Now, a conscientious editor would, as Dr. Lange has done, explain the various meanings, or shades of meaning, such a word possesses. Without such explanation, the simple vocabulary translation is absolutely worthless. We have in our remarks been assuming that the pupils will make use of the vocabulary; but we are by no means certain that they will succeed in doing so. No directions for finding the words—no *exposé* of the plan on which the vocabulary is arranged—have been vouchsafed us. The consequence is that it is almost impossible to discover how any particular word is to be found. It was only after long and patient efforts that we discovered the principle, or want of principle, on which the editors have worked. It is matter for regret when a little volume that many children who are now being bored to death by 'Readers' entirely unsuited to their abilities would have heartily welcomed, is rendered almost useless by faulty editing. The more of Hauff, and Grimm, and Brentano the children get, the better. But their works must be edited as Dr. Lange has edited 'Meister Martin,' and not as Mr. Mullins and Mr. Storr have edited Hauff's stories.

Factors in Algebra. Discovered by Arrangement, Trial, and Symmetry. With Applications. By the Rev. J. G. Easton, M.A. Groombridge and Sons.

Every teacher of Algebra knows the extreme importance of this subject, and will heartily welcome this work. Mr. Easton is a schoolmaster, and understands how to arrange his matter for pupils, young and old, though perhaps some of the chapters at the end of the little book are a trifle too long. His methods for factorising functions of three symbols is very ingenious and well worth attention. The chapter on homogeneity and symmetry is very carefully prepared, and the subject, though difficult, is cleverly handled. The examples are numerous and varied in form; the answers being given at the end of the book. We are somewhat surprised to find so little said of the application of the subject to solving quadratic equations; but on the whole we can heartily recommend it, being very cheap, to all teachers and students, though, of course, except for an advanced student, it could not be read and worked all at once. A chapter now and then would have to be introduced as one advanced with his general knowledge of Algebra.

Vergil's Æneid. Book I., with Examination Papers, Notes, and Vocabulary. By the Rev. J. Robertson, LL.D. Joseph Boulton and Co., Central School Depôt, etc.

The text in this edition is divided into passages of from twenty to thirty lines each, according to the possible division of the sentences, and opposite each of these divisions are printed ten questions of an historical, geographical, etymological, and grammatical nature. The figures of speech are carefully explained and noticed on every recurrence of them, as well as peculiarities of scanning, etc. The book is particularly adapted for boys preparing for Oxford and Cambridge local examinations, and the editor promises high places to those who will master its contents. Some of the questions are asked more than

once, and in different forms, sometimes the student being asked, for instance, to find a particular figure in the lines under examination, and sometimes asked to name the special figure used in a particular line. The little work is cheap, clearly printed, strongly bound, and thoroughly well adapted for its purpose.

Tots and Cross Tots. By the Rev. J. Robertson, LL.D. Joseph Boulton and Co., Central Book Depôt.

This is a production, copy-book in shape and size, in which the answers of the additions printed are to be actually, we presume, written by the student. This saves him all the labour of copying out a long addition question in £ s. d. The Civil Service examiners now expect their clerks to show considerable quickness as well as accuracy in performing these simple operations of adding both horizontally in numbers, as well as vertically in £ s. d. hence the name 'Tots and Cross Tots,' the latter meaning horizontal additions. As there are no farthings we presume the Civil Service does not require them. The pounds, except in the results, have never more than six figures in them, but each question consists of twenty-two lines. As the book, which is evidently very cheap, can only be used once, it is only put into a paper cover, and is well worth the enormous saving of time, though the quick and correct reading and copying of figures is quite as important an element, and requires almost as much practice as their addition. Very few, without practice, can read only once, ten figures and write them down correctly without a second glance.

Sallust's Catilina and Jugurtha. Edited with Notes by the late George Long, M.A. Second Edition Revised, with the addition of the Chief Fragments of the Histories. By J. G. Frazer, M.A. London: Whittaker and Co.

To the Latin scholar any edition bearing the name of George Long is a joy. He is sure to have a text whose revision has been care itself, even if the conclusions arrived at may not always fully commend themselves to his mind. He is sure, further, to have a series of notes of the highest critical excellence that furnish accurate information to the younger student, and invaluable suggestions to his elders. Mr. Frazer's additions to Long's 'Sallust' are in keeping with Long's own work in both these respects, and higher praise than this is scarcely possible. The only adverse feeling that arises in our mind, and it is but faintly adverse, is in regard to the fact that such work as Long's tends to perpetuate the over-exaltation of the value of classical studies that has been, and is, a hindrance to general educational advance. The boy or girl who sees the immense labour that has been spent on Mr. Long's work, and forms any conception of the time requisite for this patient comparison of texts, and this erudite working-out of grammatical, historical, geographical details, is apt first to over-estimate the importance, and, second, to be caught by the undeniable fascination of classical research. Considering the quantity and the quality of other work that has to be done, we do not want to have too large a sacrifice of our youth to the Circe of Latin scholarship.

The editions used by Long are necessarily, for the most part, German. Kortte, Jacobs, Kritz, are, together with Allen, laid under contribution. The three other famous editions (all German) of Gerlach, Jordan, Dietsch, do not seem to have been studied by Long. Fortunately, they have been by Mr. Frazer, who makes some of his most useful notes from them. Of Kritz, our editor not infrequently falls foul, and we cannot help thinking that he does so in one or two cases rather unwisely. A notable instance is, we think, in the discussion on the charge of '*Repetundæ*' against Sallust. Out of this the German certainly comes not ingloriously.

The life of Sallust that precedes the works has been known for the last fifteen years, not alone as one of the best condensations of the life of the plebeian-born quæstor, senator, tribune, prætor, legate, proconsul, historian. It is a model for condensed biography in general. The acuteness of the criticism of Sallust's writing is as noticeable as ever. Brevity and antithesis are the soul of Sallust's style, and accuracy is a secondary, tertiary, sometimes a centenary consideration. As no boy or girl is likely to work through the nearly thirty pages of excellent introduction before beginning the unequal struggle with Sallust in the text, it behoves the teacher to point out very carefully that with Sallust style is everything, and facts are—not everything. He is like our English De Quincey in this respect. Most admirable also is the *excursus* on the writing of history. It is very interesting to find Long, in 1860, fourteen years before the Short History of J. R. Green appeared, anticipating in precept the method that Green realised partly in practice. 'The labour of collecting the facts and weighing the evidence is part of an historian's work, ... and by careful examination and ordering of the facts he will make the instruction which is the purpose of history flow from the facts themselves.' This, the scientific method as applied to history, is yet in its 'go-cart.' Sallust had no conception of it; Thucydides had.

Long's own style, alike in his introduction and in his notes, is unconsciously offhand, sometimes commonplace and inelegant, and in one or two cases clumsy to the verge of violating ordinary rules of grammar. We cannot but think that in respect to his writing, his editor, Mr. Frazer, has been hampered by the publisher's injunction to alter as little as possible. The actual style, of course, cannot, should not, be touched. Such commonplaces as 'People may give a word like history almost any meaning they choose,' or such inelegancies as 'got admission to the senate,' or 'the hiding was a very proper punishment,' or 'he has the merit of doing things short,' may perhaps be allowed to stand out of a doubtful respect to the dead author. But passages like the following might surely be altered: 'The nobility, a term which comprehended those families whose ancestors had filled the high offices of the state, *and their* descendants wished to keep these offices.' 'One cannot expect boys *nor* teachers either.' All these inelegancies, or worse, appear the more marked as Mr. Frazer's own literary style, whether we take his notes or his clear and concise introduction to the Histories, is in such marked contrast. The addition of the more important fragments of the Histories makes this edition of Sallust for all practical purposes very complete. Mr. Frazer's notes throughout are quite worthy of their place side by side with Long's. Especially all students will be grateful to him for his reference to parallel passages in other authors, and more especially because so many of those authors are Greek. He might carry out this excellent principle even in dealing with Long's own writing. 'The mischief that he did died not with him' (xxi.), is not unlike, 'The evil that men do lives after them' (Julius Cæsar, iii. 2, 77).

Introduction to Geometry (for the use of Beginners), consisting of Euclid's Elements, Book I. By John Walmsley, B.A. London: Francis Hodgson, 89, Farringdon Street.

This is a new edition of a good and useful introduction to geometry, published some years ago. The author aimed at writing a book suitable for beginners, and introductory to any good edition of Euclid. A boy who worked through this manual would certainly possess a very competent knowledge of the subjects treated in the first book of Euclid. It seems to us that a little too much is expected. One hundred and fifty pages of rather closely-printed matter should surely carry us through more than one book of Euclid. The questions in what are called 'Examinations,' one would have thought, any teacher could have supplied for himself. We give a few of them:—'Familiarly explain "equilateral," "isosceles," "scalene," having regard to their derivation. Is an equilateral triangle isosceles? In what respect does a

rhombus differ from a square?' The exercises on the propositions are numerous, and often admirable. The author has printed the questions set in geometry by the Science and Art Department in the first stage for the last ten years. It seems the fashion just now to print examination questions for some years past, as though working through them would be a guarantee for passing in the future. This is a mistake. If the time spent in hunting up old questions and answering them were devoted to a real study of the subject itself, there would be an immense gain in every way. But if the questions must be printed, the author might at least have supplied such hints and references as would help a diligent boy to answer them. Will the author turn to question 8 in the set for 1884? We sent it to a junior optime, and to a wrangler; both gave it up; so did a teacher of mathematics in one of the principal colleges in London. A lecturer on mathematics at Cambridge sent a long proof, involving the sixth book. There is a short and elementary solution, but not one boy in five hundred would be likely to find it out without help.

White's Grammar School Texts. Twelfth Book of Virgil's 'Æneid.' Edited by John T. White, D.D., Oxon. London: Longmans, Green, and Co.

The happy thought embodied in this series has borne most excellent fruit since 1871, when the first was issued. Unlike the grammar school classics, one of which we have just reviewed, the texts only deal with portions of certain authors. No dictionary is needed in reading them, and scarcely any grammar. The wonderfully full and accurate vocabulary at the end quite fills the place of the former, and saves much reference to the latter, for the young student. No other books with which we are acquainted are so useful for lower-form work, and for the private student at the outset, as those of this series.

Notes on the Early Training of Children. By Mrs. Franc Malleson. London: W. Swan Sonnenschein and Co.

No father or mother could read this book without being the better for it. It deals chiefly with moral training in the nursery and during the child's early life. We cannot too strongly recommend the book. But while doing so, we do not agree with the author. Her ideal is far too high to be reached at present. To attain it we should need perfect parents, and servants in whom we could place implicit reliance. Nor do we share her utter abhorrence of corporal punishment, when used sparingly and judiciously. No doubt it has been abused. But unless revelation, nature, and experience are all wrong, pain is the just and inevitable sequel and corrective of wrong-doing. We think it should never be appealed to except as a last resort. But the attempt to abolish it altogether in all cases has not been productive of good, but quite the reverse. Parental control is not what it was; and in France, where corporal punishment is unknown, there seems to be a growing tendency to anarchy. In time we may find it unnecessary: not yet.

Outlines of Roman History. By the Rev. B. G. Jones. London: Crosby Lockwood and Co.

These outlines are of a very elementary character, and are, we suppose, only intended for small boys. The book, the author tells us, has been written and arranged on the most approved system of modern instruction for the young. We seriously doubt whether the author has made himself familiar with modern methods of instruction and the reasons for them. In 126 pages the author deals with Roman history from the earliest times to the year A.D. 476. It follows, as a matter of necessity, that we have very often little more than a bare, dry statement of facts. All that it is thought desirable that the pupil should know of Galba, Otho, and Vitellius is told in thirteen lines. How much better to have omitted it altogether! The public and the publisher generally decide whether a book is unsuccessful. We leave them to do so in this case.

Electrical Units. By Dr. Wormell. London: Thomas Murby.

This is a shilling manual on Electrical Units, intended as an appendix to the author's lectures on Magnetism and Electricity. Like all the author's books, this is clear and accurate. It can be used in connection with any text-book on Electricity. Students in science classes will find it very useful. Those who bought copies as soon as the book was issued will correct the slip by which the Farad was described as a fraction of the electrostatic C.G.S. unit, instead of the electro-magnetic unit. The error has since been corrected.

Hints and Rules to correct some Common Mistakes in Classical Composition. London: Relfe Brothers.

This is a small pamphlet, after the style of Farrar's 'Rules of Greek Syntax,' and Wilkin's 'Rules of Latin Syntax.' There are thirty-two headings, under which the commonest mistakes in Greek and Latin composition are classified. The rules are stated clearly and concisely. It is a useful book.

Key, Hydrostatics and Pneumatics. By Philip Magnus. London: Longmans and Co.

This contains the solutions of all the examples in the author's manual on Hydrostatics and Pneumatics. Keys are questionable aids. At the present time, however, there are many private students who cannot avail themselves of suitable instruction, and to such persons a key is often of great use, especially if, as we know is often the case, it is judiciously used.

Analysis of the First Book of Samuel. With Notes, Critical, Historical, and Geographical. By Lewis Hughes, B.A. London: John Heywood.

How far middle-class education has been affected by the Oxford and Cambridge Local Examinations we shall not fully see until those who have been educated under its influence are the strength of the nation. No time could have been happier for its introduction than when elementary education, under eminent inspectors, was making such mighty strides.

Thanks to these practical inspections of uninspected schools, middle-class education has even almost more advanced than that of the lower orders. A comparison of the grammar or commercial school of the present day with what it was thirty, or even twenty, years ago would show greater results than a like comparison between the modern Board-school of to-day and the village school of 1840 or 1850. By no means the least advantage gained is the supply of first-class, well-printed, cheap manuals, whose very existence was made necessary by these separate examinations.

In examining these manuals, what we have to look to is method of arrangement. Criticism we don't expect; but what we do expect is perspicuity, to enable the student to learn what he is to supposed to know in the shortest and most permanent way. The book before us is not Mr. Hughes' first effort, having already helped in preparing other books of the Bible. The usual marking which a student would adopt to draw his attention to what he would recollect is here cleverly done for him by the use of thicker type. At the end of every chapter there is a set of questions, and at the end of the volume a map and tables of events, places, etc., with one paper covering the whole book. With such a book, well worked, one is not astonished that the examiners always expect a fair number of boys and girls to get full marks, as some, at least, always do.

The Public Schools Historical Atlas. Edited by C. Colbeck, M.A. London: Longmans, Green, and Co.

Mr. Colbeck has here collected into a small, square volume the maps which have been published in the 'Epochs of Modern History,' of which he is now the editor. In addition to these, he has himself prepared those which were wanting to complete the series.

Before speaking of their object we may at once recommend the volume for its clearness of execution and beauty of appearance. The maps are carefully coloured, and not over-crowded with names so as to make them illegible. There are no less than 101, some full-page and some smaller, but all equally clear.

Though stated to be the maps from 'Epochs in Modern History,' yet the first gives us a sketch of the Roman Empire in the fourth century, taken from Church's 'Middle Ages.' There are several plans of battles, sieges, and towns, the atlas concluding with a plan of the battle of Waterloo.

At the foot of each map is the name of the book whence it is reprinted. We were particularly struck with the map of England giving the position of the battlefields of the Wars of the Roses, the towns besieged, other places of importance at the time, and nothing more.

Every teacher knows how important it is to teach one thing at a time, and that is just what these maps, either in the smallness of area depicted, or the fewness of names given, do.

At the end of the volume there is a well-arranged index, in which the places are discoverable by means of letters and Roman numerals, and not by longitude and latitude, though the longitude and latitude is, in nearly all cases, except in the battle plans, given.

The reason, no doubt, of this departure, which at first sight seems unwise, is to reduce the method of reference in towns—where longitude and latitude would be impossible—similar to that of larger areas.

Publications Received.

Alexander and Shepheard—
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Blackie and Son—
Magnetism and Electricity. Part III.
Shakespeare's Tempest, with Notes.
Maps (Geographical Series).

Heywood (John)—
Analysis of the First Book of Samuel.
Gardiner's Explanatory Geography. Standard VI.
Home Lesson Book to Fourth Paragon Reader.
" " " First "
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The Ink Syphon.
The New Code Singing Book. Book No. 4.
" " " (Staff Notation). By J. Clifft Wade.
" " " (Sol-fa Notation) " "

Johnston (W. and A. K.)—
Johnston's Map of Egypt and the Basin of the Nile.
Physical Map of England and Wales, with Handbook.

Longmans and Co.—
The Sun and His Phenomena.

Miscellaneous—
The Cornhill Magazine (March).

Pitman (F.)—
Marche Soudanese.

Relfe Brothers—
Elementary Help Notes on Latin Parts of Speech and Sentences. By W. Thornton Bullock, M.A.

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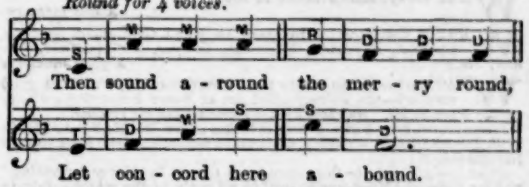

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